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Botanic gardens as 21st Century enablers of plant diversity conservation for human welfare

Botanic gardens and the conservation of Australian native plants: examples from Kings Park and Botanic Garden, Perth

Plant conservation research at Adelaide Botanic Gardens: addressing threats to critically endangered species

Germination data sharing @ the Royal Tasmanian Botanical Gardens, Hobart

And much much more …

SPECIAL THEME: BOTANIC GARDENS AND PLANT CONSERVATION

This issue

Regular Features

Australasian Plant Conservation

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"To promote and improve plant conservation"

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Australasian Plant Conservation is a forum for information exchange for all those involved in plant conservation: please use it to share your work with others. Articles, information snippets, details of new publications or research, and diary dates are welcome. **The deadline for the December 2009—February 2010 issue is Friday 27 November 2009.** The theme of that issue will be **'Local governments and plant conservation'.** General articles are also very welcome.Please contact Rosemary Purdie if you are intending to submit an article: Rosemary.Purdie@environment.gov.au.

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Please send articles, no more than 1100 words, as a MS Word (2000 compatible) or rich text format file, on disk or by email to: Rosemary.Purdie@environment.gov.au.

Front cover: Top: threatened species *Omphalea celata* at Mackay Regional Botanic Gardens (left; photo: Dale Arvidsson) and *Graptophyllum excelsum* at Gladstone Tondoon Botanic Gardens (right; photo: Brent Braddick), and seed biology testing targets of Rainforest Seed Project at Mount Annan Botanic Garden (centre; photo: S. Cottrell). Main: alpine areas of Kosciuszko National Park, the subject of conservation research by the Australian National Botanic Gardens (photo: R. Purdie).
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From the Editor

Rosemary Purdie

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Mention botanic gardens, and most people think of stately trees, garden beds and spring flower displays; nooks of beauty, peace and tranquillity; coffee with friends and family picnics; and places for jogging, weddings and summer concerts or films. Less often known or recognised is the strong scientific work of many botanic gardens. This includes herbarium collections, taxonomic and horticultural research and plant conservation activities. It is the latter aspect that we explore in this issue of *Australasian Plant Conservation*, noting that it is often intertwined with other aspects of the gardens' work.

Guest Editor Stephen Hopper, Director of the Royal Botanic Gardens, Kew provides a backdrop to the issue. He highlights the current global biodiversity extinction crisis arising from the multitude of threats (most related to human activities) to the survival of species in their natural environments. He notes the multiple benefits of plants to humans (i.e. the ecosystem services plants provide) and the ongoing importance of plants as we work to address the 'inescapable environmental challenges' facing the world's biodiversity. His message is that botanic gardens have a pivotal role to play as part of global efforts to help conserve our plant species.

So how are Australia's botanic gardens filling this role? There are over 160 botanic gardens and arboreta in Australia (see <www.anbg.gov.au/chabg/bg-dir/>), one or more in each of the capital cities and the rest scattered throughout regional areas. Many do not (or do not yet) have a conservation focus to their work. However the stories in this issue highlight the many activities that are being carried out or planned for the future. The stories are from six major botanic gardens (in Perth, Adelaide, Hobart, Melbourne, Canberra and Sydney) and four regional botanic gardens (in Alice Springs, Mackay and Gladstone and near Bateman's Bay).

These gardens' plant conservation activities have a strong (but not exclusive) focus on threatened plant species, with some gardens also working to understanding the role of plants in ecosystem functioning. The work carried out is frequently in collaboration with government agencies, universities and other research bodies, although volunteer groups and schools can also be important partners.

The activities described in this issue include maintaining seed banks of native plants and building knowledge about their storage and germination requirements. Many gardens are researching the ecology and genetics of threatened species and are actively propagating them for inclusion in their living collections and/or for the establishment of translocated populations in the wild. Community education is also an important part of the gardens' plant conservation work, sometimes starting from quite unexpected quarters!

The focus on botanic gardens is rounded off with an article about the role of the Council of Heads of Australia's Botanic Gardens, and the increasing role it has been playing in targeting and coordinating their conservation activities.

The issue concludes with our regular features after two final articles. The first article is an update on the Australian Plant Census, the nationally agreed list of scientific names for our flora, and the second a taste of what will be a series of reports from 'ANPC abroad'. Curious? Read on, and enjoy this issue.

ANPC Annual General Meeting

12:30-1:30 pm, Friday 27 November, 2009

Dickson Room, Australian National Botanic Gardens, Canberra

For those not located in Canberra, please plan to attend by phone hook-up.
Further details about the AGM are provided in the material enclosed with this issue of APC.

GUEST EDITORIAL

Botanic gardens as 21st Century enablers of plant diversity conservation for human welfare

Stephen D. Hopper

Director, Royal Botanic Gardens, Kew, UK.

The development of botanic gardens is a global growth industry. Of the more than 2500 significant botanic gardens around the world, half have been created since 1950. Australia conforms to this trend.

Why is this so? Clearly, communities value and consider it worthwhile investing in botanic gardens—for the local community's enjoyment and recreation, for tourism, for conservation, for education and for ongoing scientific discovery. This is healthy, essential and timely, enabling better conservation and use of plant diversity for human welfare in a time of rapid global change.

Indeed, I suggest that at no other point in history have plants and botanic gardens been more important to the future of humans, and of life on Earth. If this contention is correct, it is all the more distressing that, while botanic gardens continue to diversify and thrive, biodiversity has taken such a hard hit globally over recent decades, despite growing awareness of its decimation. Few would question that an extinction crisis is underway. Why is more not done to address this crisis? Is this due to poor understanding, lack of engagement or lack of commitment and sufficient action? What can botanic gardens do?

The world's population is not lacking a broad understanding of the natural world. Such public awareness owes much to decades of brilliant documentaries by Sir David Attenborough and countless other enthusiasts for natural history. Something else must account for the increasingly alarming plight of life on Earth, and apparent indifference to the situation.

Of course, not all are indifferent. Australia has many fine examples of work aimed at conserving its biological jewels: magnificent national parks and nature reserves; extensive state forests; private land with wild vegetation retained for posterity by enlightened owners; and road verges similarly burgeoning with unique plants and animals persisting on slivers across the landscape.

Many threatened Australian species have been saved from extinction by the good work of committed conservation biologists, land managers and others. Seeds of native plants are being collected, stored and used as never before to repair damaged landscapes.

At the same time, the impact of people and choices in land use detrimental to biodiversity and to ourselves are to be seen everywhere, from extensive clearing for agriculture, infrastructure and ever-expanding cities, to the drying of climate associated with global warming. Water sources are being taxed to the limit. Applications of fertilisers are acidifying the land, poisoning plants and other organisms, and causing toxic algal blooms in wetlands.

Salinity due to excessive destruction of native vegetation silently consumes vast areas of Australia's agricultural lands, including towns and roads as well as farmland and bushland alike. Dieback disease spread by moving infected soil is destroying more native plants than in any other region on Earth. Invasive weeds are more numerous and malignant to native plants and animals. Feral animals such as foxes and rabbits abound, the direct consequences of contemporary life styles.

We are literally poisoning our own nest, knowingly or not, silently, in what has been, and could continue to be, a global paradise.

At some point, soon, such approaches to land and water management must turn the corner. Green economics is now receiving serious mainstream attention across the world, no longer regarded as a catch cry of marginal extremists. We must develop a new paradigm for sustainable living over the next decade or two. The economics point more and more clearly in this direction. The environmental signals do likewise. The need is evident. It's now time for concerted action, in all walks of life. Many are already grasping this nettle, especially young people who have most to lose and most to gain. While change is sometimes difficult, there are also superb opportunities and benefits for all if we seize the day.

Biodiversity, especially plant life, offers great potential to help with solutions to the inescapable environmental challenges we all face. Plants absorb carbon, and therefore help cool the world. They provide oxygen, so you and I can breathe. They provide food at a time where the word 'crisis' is now being used for the supply of staples that feed the world. Plants provide filters in the landscape for clean water. They enrich and modify hostile soils. They are a source of medicines for human health; quinine from cinchona bark and now *Artemesia annua* remain the best defences against the world's greatest killing disease—malaria. Some Australian plants are known to have anti-cancer, anti-bacterial and anti-viral activity.

Does the plant biodiversity of Australia matter? Absolutely. As one of the world's great repositories of biological novelty, many solutions to sustainable living undoubtedly lie quiescent and as yet unrevealed in remnant patches of native vegetation.

We know from Aboriginal people that there is a rich array of useful foods, medicines and culturally significant plants and animals found in Australia and nowhere else on Earth. The Australian native flora has already given the world edible crops such as macadamia nuts, sandalwood for aromatic oils, some of the most durable hardwoods for furniture making on Earth, and many plants adapted to saline habitats for land reclamation. New plants for perennial cropping sit largely unrecognised at our doorstep. Wildflowers of exquisite beauty and intrinsic interest still adorn remnant vegetation across the nation. Animals of great antiquity and such novel biology abound.

If we are to retain and restore the Earth's vegetated carbon sinks to help minimise global warming, all people must look to their own backyards and manage biodiversity as though they were here to stay on this planet, in their place, living lives enriched by biodiversity. Australians bear a special responsibility as custodians of one of the most important biodiversity regions on Earth.

Will we save it? I sincerely hope we do. We cannot afford to let such riches slip through our fingers, for self-preservation as much as for the intrinsic interest and wonderment for which the Australian biodiversity has become internationally renowned.

How? By valuing, celebrating and investing in biodiversity. A step change in conservation action and financial resources for biodiversity is needed. Investing the cost of a few jumbo jets in Australian plant biodiversity over the next few decades would reap irreplaceable long-term rewards.

Such investment has already started, ranging from substantial work and contributions from government, business and wealthy individuals through to those of more modest resources establishing native plant gardens in their backyards or helping as volunteers with conservation organisations. We must ensure that this work continues and accelerates.

As the world moves through the present financial crisis, in a new era of environmental challenge, the opportunity exists to rethink our world and ways of living. Great historical moments such as the abolishment of slavery or democratising South Africa demonstrate we are capable of enlightened transformation as a global society, despite the economic and political difficulties. We owe it to ourselves, our families and the future to ensure today's new deal for the environment and biodiversity becomes such a transformation.

I would conclude by simply saying that botanic gardens have a pivotal role to play now and in the future in this challenging enterprise, from scientific discovery, documenting and demonstrating the value of plant life, through seed banking, to helping restore damaged carbon sinks and plant diversity essential for a sustainable future. We need to harness the strong community interest in botanic gardens towards helping conserve plant biodiversity. If botanic gardens can't achieve this, who will?

Displays of native plants at Mount Annan Botanic Garden. Living plant collections help educate the public about the importance of plant biodiversity. Photo: Murray Fagg.

Botanic gardens and the conservation of Australian native plants: examples from Kings Park and Botanic Garden, Perth

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Introduction

A recognised function of botanic gardens in Australia is to document and display plant diversity to achieve a range of scientific and conservation outcomes. Over the past 20 years many botanic gardens have increased their activities in the protection and conservation of plant diversity, and in restoration related activities. This is partly in response to a range of international agendas and strategies focussed on the conservation and sustainable use of plant diversity or biological resources generally—the Convention on Biological Diversity (1992), the Gran Canaria Declaration (2000), the International Agenda for Botanic Gardens in Conservation (2000), the Global Strategy for Plant Conservation (2002), and the Gran Canaria Declaration II (2006).

Australia's botanic gardens have the research and horticultural skills and facilities that make them well placed to partner with other institutions and organisations to achieve the targets proposed in these international agendas and strategies and deliver improved conservation outcomes.

The focus by botanic gardens on plant conservation has gained further impetus with increased understanding about the likely impact of changes in the world's climate on plants and landscapes. Climate change will have major and long-lasting impacts on natural ecosystems, requiring increased and targeted activity and a preparedness to try new and novel approaches to plant conservation and ecosystem restoration.

Under the latest climate change scenario, as many as half of the estimated 400 000 plant species in existence today may be under threat of extinction (Bramwell 2007). In 2006, Australia's *State of the Environment Report* identified biodiversity loss as the most significant problem facing the nation in the next millennium. It is estimated that 48 plant species have already gone extinct in Australia, and another 1278 are considered critically endangered, endangered or threatened (Department of the Environment, Water, Heritage and the Arts 2009).

Plant conservation can be achieved through an integrated approach combining *in situ* and *ex situ* conservation strategies. *Ex situ* conservation, mainly via living collections and seedbanks, is a core strength of botanic gardens. Most major Australian gardens hold several thousand accessions of native plant species, while it is estimated more than 6.13 million accessions are held in 4 million living collections in botanic gardens worldwide, representing more than one third of the total number of known vascular species (Botanic Gardens Conservation International 2009).

Part of the seed sorting and storage facilities at Kings Park. Photo: Luke Sweedman

Living collections

Botanic gardens can use their taxonomic and horticultural research expertise, nursery facilities and living collections to assist conservation outcomes. For example, *Grevillea scapigera* was a critically endangered species restricted to just three wild plants near Corrigin, 235 km south-west of Perth in Western Australia.

For over 15 years, Kings Park and Botanic Garden has partnered with the Western Australian Department of Environment and Conservation, community groups and volunteers in a species recovery program. Integrating scientific research (tissue culture and seed germination) with traditional horticultural disciplines, plants grown at Kings Park were used to populate three translocation sites that now contain over 400 plants. Large amounts of

seed have been produced from these seedlings and added to the soil seedbank.

Natural recruitment of *Grevillea scapigera* first occurred in 2003, and some of these plants have flowered and produced seed. Clones of the original plants representing 87 per cent of the known genetic diversity of this species are now held in living collections and cryostorage (i.e. at extremely low temperatures) at Kings Park. These actions have collectively improved the likelihood of a successful long-term outcome for this species.

In 2004, Kings Park and Botanic Garden developed a five year integrated conservation plan for the recovery of *Caladenia huegelii*. This critically endangered terrestrial orchid is endemic to the Swan Coastal Plain near Perth, and south of Perth. To commence the project, the known populations were surveyed and their genetic diversity documented, mycorrhizal associations investigated, germination procedures and growing requirements understood, and transplant procedures developed. As a result of this work involving community groups and volunteers, re-introduction programs *in situ* are now being progressed.

Seedbanks

All capital city and some regional botanic gardens in Australia have seedbanks for the storage of local and/or state-wide native plant species. These seedbanks provide a high level of protection and security for key species, including threatened flora and endemic species, and allow the seed to be used in research projects and *in situ* conservation and restoration activities.

The Millennium Seed Bank project is an international conservation activity coordinated by the Royal Botanic Gardens, Kew in the United Kingdom. Established in 2000, the project is supported by botanic gardens, universities, environmental agencies and other partners in over 18 countries, including a program in each state and territory of Australia. The aim of the project is to collect and conserve seed of 10 per cent of the world's flora by 2010, mainly of dryland species, to provide an insurance policy against the extinction of plants in the wild and to store the seeds for future use (Royal Botanic Gardens, Kew 2008).

Kings Park and Botanic Garden has a seedbank collection of 3400 native plant species and, together with the state's Department of Environment and Conservation, has achieved part of target 8 of the Global Strategy for Plant Conservation (2002), to have *60% of threatened plant species in accessible ex situ collections, preferably in the country of origin.* The next phase of the Millennium Seed Bank project will aim to bank 25 per cent of the world's flora by 2020, targeting species and regions most at risk from climate change and to build a global network to restore damaged habitats.

This Grevillea scapigera *restoration site, flowering in October 2006, yielded an estimated one million seeds. Photo Bob Dixon.*

Conclusion

'The conservation mantra is … turning towards how habitats can be rebuilt, revitalised and restored, heralding a new era and new opportunities for botanic gardens as "restoration hubs" ' (Dixon and Sharrock 2009). Accordingly, Australia's botanic gardens can play an important role as 'Conservation Arks' delivering science and conservation outcomes in partnership with universities, environmental agencies, not-for-profit groups and volunteers.

Botanic gardens have embraced the call to action to conserve native flora and become advocates for the research and conservation of biodiversity generally. With about 15 million visits made each year to botanic gardens in Australia, they are also key players in the critical function of public education and interpretation about the importance of conservation of plants, ecosystems and landscapes for the health and well-being of current and future generations of human kind.

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Plant conservation research at Adelaide Botanic Gardens: addressing threats to critically endangered species

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The Botanic Gardens of Adelaide has been involved in conservation research for over 20 years. Studies have focussed on improving our understanding of the biology and ecology of the threatened flora of South Australia, so that recovery and management plans for these species are better informed by accurate scientific knowledge.

Conservation research

The populations of many endangered plants are small and fragmented, often being restricted to roadsides or small scrub patches in largely cleared agricultural regions of the state. Much of our conservation research is focussed on the delineation of threats to a species' ongoing sustainability, and how these may be overcome to improve population management. Studies of reproductive biology and seed bank dynamics can tell us whether factors associated with fecundity or seed dispersal are limiting recruitment of the next generation. Studying responses of threatened species to fire informs us about regeneration mechanisms and safe fire frequencies. Genetic studies unveil issues associated with clonality or inbreeding in small populations.

Plant translocation

For some endangered species, augmentation of existing populations or the construction of new populations by translocation (deliberate transfer of plants from an *ex situ* collection to an existing or new location in the wild) may be considered appropriate. This is usually preceded by trial translocations, which are a useful tool for refining procedural and technical details for large scale translocations. Studies on propagation physiology may also form part of this research. Recently, translocation was used to successfully augment a wild population of *Acacia whibleyana* by 25 per cent, thereby broadening the age distribution of plants in the population and boosting fecundity (Jusaitis and Sorensen 2007).

Target species

The plants targeted for specific conservation research represent some of the state's most critically endangered species. Those currently under study include two wattles (*Acacia cretacea* and *A. whibleyana*), two daisies (*Acanthocladium dockeri* and *Brachyscome muelleri*), a raspwort (*Haloragis eyreana*), several terrestrial orchids (*Caladenia behrii, Pterostylis arenicola* and *Pterostylis* 'Halbury') and a grass (*Lachnagrostis limitanea*).

Figure 1. This special incubator will help scientists to determine the impact of climate change on seed germination. Photo: Brett Hartwig.

Seed conservation

Over the last six years the Botanic Gardens of Adelaide has increased its focus on using seed banking as a conservation tool for threatened plant species. The SACRED Seeds project, a collaboration between the Botanic Gardens of Adelaide and Millennium Seed Bank, has seen more than 2300 seed collections made, representing over 1150 of South Australia's native plant species. So far more than 166 million seeds have been processed and entered into long-term storage. Seed collections have been made for 40 per cent of South Australia's 800 threatened plants, and species including the Mountain Scurf Pea (*Cullen microcephalum*) and Showy Viola (*Viola betonicifolia* subsp. *betonicifolia*) that were presumed extinct in South Australia have been rediscovered.

Many of the species that have been collected are extremely difficult to propagate from seed due to issues associated with seed dormancy. In an effort to improve our knowledge about seed biology, germination trials have been completed for over 550 species. For those which continue to prove difficult to germinate, larger scale experiments are conducted, combining both laboratory (*ex situ*) and field based (*in situ*) experiments. The inclusion of the latter provides an opportunity to expose seeds to natural environmental conditions and climatic variations that are extremely difficult to replicate in the laboratory. This approach has allowed germination protocols to be developed for some of South Australia's rarest and most difficult to germinate species, including the Monarto Mint Bush (*Prostanthera eurybioides;* Ainsley *et al*., 2008) and the Slender Bell Fruit (*Codonocarpus pyramidalis*).

Research is also underway to determine the potential impact of climate change on seed germination in threatened species. Using a purpose-built incubator that can test up to 196 temperature combinations at the one time (Figure 1), the ability of seeds to germinate under altered temperature and rainfall regimes is being examined.

As an extension of our seed program, plants for 34 threatened species grown from seeds stored in the seedbank have been provided to a range of stakeholders for use in restoration activities. The stakeholders include the Department for Environment and Heritage, Forestry SA, SA Water, private land managers and community groups.

Case study

Spiny Daisy (*Acanthocladium dockeri*) is a critically endangered shrub occurring in five roadside populations in the arable Mid-North of South Australia. Each population is relatively small and compact in structure and the total number of remaining plants has been estimated at less than 3000. Our research showed that even though plants flowered prolifically, very few viable seeds were produced due to low pollen viability (Jusaitis 2008). No regenerating seedlings were observed in any population, raising the possibility that genetic diversity within each population was likely to be low.

We carried out a series of genetic tests which confirmed that each natural population consists of a single, distinct, genetic clone, proliferating vegetatively by root suckering (Jusaitis and Adams 2005). This means, in effect, that there are only five genetically distinct plants left in the wild. The loss of any one population would result in a 20 per cent reduction in the genetic diversity remaining within the species. Thus, despite the seemingly large number of plants remaining, this species is in urgent need of active conservation management.

Further research showed that introduced white snails were a severe threat to plant survival and vigour in most populations, causing death to shoots and whole plants by ringbarking stems during autumn and winter. Fire was found to destroy the resident snail population, giving plants a temporary reprieve from grazing damage for up to three years post-fire. Spiny Daisy was found to be tolerant of burning when it resprouted successfully after a bushfire (Jusaitis 2007). Weeds were present in all populations and presented a potential threat to population regeneration and expansion by competing for resources.

Figure 2. Trial translocation of Acanthocladium dockeri *in South Australia's Mid North. Photo: Manfred Jusaitis.*

These results led to the recommendation that all five remaining clones be preserved in their respective habitats, ensuring each population is secure and local threats (snails, weeds) are eliminated or controlled. Snails could be controlled on a small scale by baiting, but if numbers were excessive, burning could be used to provide a successful longer term control strategy.

Micropropagation techniques were developed, the use of cryopreservation (extremely cold temperatures) as an *ex situ* conservation approach investigated and several new populations have been initiated through translocation (Figure 2) to spread risk and enhance population security. Regular and ongoing snail baiting and weed control are occurring at each population as part of local site management of the species. Further research is currently in progress to assess the potential consequences of mixing genotypes from different populations together.

Conclusion

The long-term aim of conservation studies at the Botanic Gardens of Adelaide is to support the preservation of threatened plant populations in their natural habitats for future generations to enjoy and utilise. A variety of methods has been used to achieve this aim, and includes field and laboratory based research, seed collection and banking, propagation, cultivation and translocation of threatened plants. With the ever increasing threat of global climate change, botanic gardens are also uniquely positioned to facilitate research on how it will impact the conservation and management of Australia's threatened plant communities.

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Germination data sharing @ the Royal Tasmanian Botanical Gardens, Hobart

James Wood and Mark Fountain

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Trying to find information on germinating wild plant species is often a frustrating process. This aspect of the flora has not been researched to any great degree and much of the work that has been done is scattered through books and journals making access to information for smaller institutions and individuals difficult. For this reason Seed Safe—a collaboration between the UK's Royal Botanic Gardens, Kew, the Royal Tasmanian Botanical Gardens (the Gardens), the Biodiversity Conservation Branch in the Department of Primary Industry Parks Water and Environment, and the Tasmanian Herbarium at the Tasmanian Museum and Art Gallery—is proud to announce that the Germination Database of the Tasmanian Seed Conservation Centre is now publicly available on the Gardens website.

Based on the principle of Open Disclosure set out in the Gardens' Plant Conservation Policy, which states 'we will endeavour to make all our conservation data and information publicly available as soon as practically possible', we believe this information will be most valuable where it can be freely accessed by all.

The database already contains the results of over 2000 tests on over 400 vascular plant taxa growing in Tasmania. We will be updating the database several times a year to incorporate the latest results from germination testing taking place at the Tasmanian Seed Conservation Centre. Long-term, the seedbank aims to hold multiple provenance collections for most of Tasmania's flora, and we expect to conduct germination tests on most of our collections.

In addition, we have provided over 28 pages of supporting content to explain the principles of seed conservation, the science of seed germination and dormancy and how the laboratory techniques used at the Tasmanian Seed Conservation Centre can be adapted to home use.

Relevant web addresses are:

- main index page: <www.rtbg.tas.gov.au/seedbio>
- Tasmanian Seed Conservation Centre: <www.rtbg.tas.gov.au/tscc>
- germination database: <www.rtbg.tas.gov.au/tasgerm>

Feedback on the germination data and the support pages from users would be greatly appreciated. Contact the Seed Conservation Centre Coordinator, James Wood (James.Wood@rtbg.tas.gov.au).

*The endemic Tasmanian Native Plum (*Cenarrhenes nitida*) germinating at the Tasmanian Seed Conservation Centre.* Cenarrhenes *is a member of the Family Proteaceae and produces a black fleshy fruit containing a single-seeded, woody stone. These stones are readily split by the seedling during the germination process. Provisional results from testing indicate that this species possesses physiological dormancy. Germination takes place at temperatures of 20°C or higher, but only after at least two months of cold stratification. Photo: James Wood.*

Understanding species and landscapes: conservation research at the Royal Botanic Gardens Melbourne

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We know that all environments are affected by human activity and to some extent the role of botanic gardens in conservation has been directed by rapid changes wrought by more recent human activity. At the Royal Botanic Gardens Melbourne our research aims to address questions that we face in managing landscapes to retain both species and functionality.

While much conservation research focuses on rare and declining species, other species whose ranges are increasing can also pose problems for management, often in the same landscape. In particular, degraded sites may be the only location of rare species that are out-competed by species more suited to the altered environment. The Gardens Herbarium collections provide a historical perspective on species distribution and abundance, albeit with a collector's bias. They can be used to track species decline, the first record of introduced species, the spread of weeds and also changing distribution patterns for native species.

Current studies at the Gardens incorporate genetic analyses based on DNA sequencing and microsatellite markers (small repetitive DNA sequences that vary in length, often between individuals or family groups). Depending on the technique chosen, a molecular ecological approach can be used to identify genetic differences between individuals, understand local and regional population structures, track the mobility of individuals and their gametes/genes and uncover mating systems. This approach has been successful for a number of studies at the Gardens, a few of which are outlined below.

Connectivity and dispersal in the Gippsland Lakes

One project underway is a study of the role of dispersal in maintaining aquatic plant diversity at landscape scales, with the Gardens and Monash University among the collaborators. The aim is to identify approaches for the conservation of plant biodiversity in aquatic ecosystems through an improved understanding of the contribution of wind, water and waterbirds in the dispersal of aquatic plants. The study is based in the Gippsland Lakes, a region internationally recognised under the Ramsar Convention for the environmental significance of its landforms, vegetation and fauna, particularly water birds.

We are assessing dispersal modes by monitoring the movement of seed in and out of wetlands and by determining genetic structure across the Gippsland Lakes of two model wetland species with different primary modes of dispersal. *Phragmites australis* (Common Reed) is a wind-pollinated and wind-dispersed native grass that is also one of the most widespread plant species worldwide. The second species, *Triglochin procera* (Water Ribbon), is dispersed primarily by water but water birds may also play a role. Like many aquatic plants, both species are polyploid (i.e. their cells have three or more full sets of chromosomes) and can reproduce vegetatively by rhizomes (*Phragmites*) or tubers (*Triglochin*), adding an extra challenge to interpreting genetic data.

In some areas *Phragmites* has declined while in others it has expanded even under increasing salinity levels. Changed hydrological conditions may be the cause, but we are also comparing chloroplast DNA sequences from Gippsland plants to *Phragmites* around the world. This is important to identify whether a highly invasive Eurasian haplotype (i.e. a form with a particular genetic makeup), established in North America, is present in Victoria. If so, the management requirements change, but so far so good, our tests have revealed nothing sinister.

Conservation biology of holly-leafed grevilleas

The loosely grouped 'holly-leafed' grevilleas continue to be an ongoing interest of the Gardens. Broad-based studies of the group underlie more discrete projects designed to identify limiting factors in distribution, such as reproductive method, breeding system and habitat loss, while information on the partitioning of genetic variation can assist in understanding gene flow across each species' range. In Victoria, *Grevillea aquifolium* is found across the western part of the state. It is morphologically variable, has different growth habits and is found in a range of habitats. Moving eastwards, the species has more restricted occurrences.

The first species studied was *G. infecunda,* which was found to be male sterile thus explaining the lack of seed despite good flowering. This is in contrast to *G. renwickiana,* restricted to a few sites near Braidwood in New South Wales, which rarely flowers. Genetic analysis of the latter species has revealed extensive clonality, with fewer than 25 genetic individuals identified and indications of genetic abnormalities. Both species rely on vegetative reproduction from rhizomes for their persistence.

Gareth Holmes' PhD study (2008) provided the first evolutionary relationships (i.e. phylogeny) of the group and a population study of *G. repens,* which has a disjunct distribution to the east and west of Melbourne. The phylogeny provided some interesting placements of species. For example, *G. infecunda* was previously considered to be a sterile variant of *G. aquifolium*, but grouped with the geographically closer species, *G. steiglitziana*, from the Brisbane Ranges.

Gareth found that populations of *G. repens* display significant genetic differentiation based on microsatellite data, which supports the hypothesis that eastern and western portions of its range have been historically isolated. Interestingly, these population groups appear to be following different evolutionary trajectories: those from the east show some evidence of mixed ploidy (diploids and triploids) and clonal spread via root-suckers, while western populations appear to be diploid and lack clonal reproduction.

Currently, Trisha Downing from The University of Melbourne is studying relationships within *G. aquifolium* based on morphological variation (morphometrics), DNA sequence variation and microsatellite variation for her PhD.

The Gardens and Susan Hoebee, La Trobe University, have two Honours students who have recently started projects on Victorian *Grevillea* species. Gerry Ho is studying the highly restricted *G. obtecta,* also a holly-leafed grevillea, to provide information on the genetic similarity between morphological forms informally described in the species. Juli Atkinson has begun her project studying *G. chrysophaea*, a Victorian species more closely related to *G. celata* than the holly-leafed grevilleas, with disjunct occurrences from west of Melbourne into Gippsland to the east. Like *G. obtecta*, it has informally recognised forms and molecular markers will be used to compare geographic and genetic distance with the morphological forms.

As we build up information on habitat, genetic variation and reproduction on restricted and more widely distributed *Grevillea* we will have a better basis for the design and implementation of recovery plans for these and similar species.

Lost and found species

A couple of the Gardens' projects fit into this category. *Pimelea spinescens* subsp. *spinescens* is dotted across Victoria and was thought to be the only extant representative of the species. That is, until 2005 when *P. spinescens* subsp. *publiflora* was re-discovered near Natimuk in the Wimmera, followed by a second population at Minyip in 2007. Pauline Rudolph (Department of Sustainability and Environment) has been monitoring the two sites for growth, flowering and seed production, and Deborah Reynolds, a PhD student from Victoria University, is studying the ecology of *P. spinescens* subsp. *spinescens*. Both subspecies appear to be very long-lived but their life histories are still a mystery.

(top to bottom): Rebecca Citroen wading across a lake to collect Phragmites. *A rare sighting of* Grevillea renwickiana *in bud. Photos: Gavan McCarthy.*

A second species, *Senecio behrianus* went AWOL for decades but re-emerged in an area outside its historic range with a disjunct distribution. We are testing microsatellites developed in conjunction with the Centre for Stress Adaptation Research at Bio21, The University of Melbourne, and Royal Botanic Gardens Sydney. These microsatellites will be used to assess the genetic variability and population structure in both species.

Conclusion

The Royal Botanic Gardens Melbourne conservation projects are collaborative and integrated across disciplines. They are designed to be informative at various levels and to provide information that is both practical for the conservation of our native plant species and bring a greater understanding of their evolution.

Ex situ success: the role of the Australian National Botanic Gardens in native plant conservation

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In an ideal world all plants would be protected *in situ* in their natural habitat. However, in a less than ideal world, dramatic changes to habitat such as natural disaster, land clearing and climate change may make it impossible for a plant to survive in its natural range. An alternative is *ex situ* (off-site) conservation where viable plant parts such as seeds, spores, tissue or whole plants are collected from the wild and either cultivated or stored. In this way *ex situ* conservation serves as a safety net or insurance policy, with plant material conserved until reintroduction can be attempted.

Botanic gardens clearly play a critical role in *ex situ* conservation. Aplin (2008, p. 191) argues that they are the 'greatest contributors of *ex situ* conservation, utilising methods such as seed banking, cryopreservation, tissue culture and the cultivation of plants'. The Australian National Botanic Gardens living collection currently features over 6000 species, over 60 000 individual plants and a seedbank comprising approximately 3000 taxa. Its contribution to plant conservation is exemplified in one case study of successful *ex situ* conservation and its potential involvement in a second.

Hakea pulvinifera—a success story

One of the *ex situ* propagation successes at the Gardens has been the endangered species *Hakea pulvinifera*. This species is represented in the wild by less than 150 plants on a slope above the Namoi River near Gunnedah, New South Wales. It is listed as endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the New South Wales *Threatened Species Conservation Act 1995* (NSW National Parks and Wildlife Service 2000).

Hakea pulvinifera is a root suckering shrub up to 2.2 m high with thick tessellated 'cork-like' bark, typically pointy *Hakea* leaves and creamy white flowers (Figure 1). The plants appear to be sterile with no fruiting or seed set recorded since the species was discovered in 1949. Instead, it appears to reproduce via root suckering.

It is likely that *H. pulvinifera* was never widespread or abundant prior to European settlement and we may be witnessing a natural extinction event. Given its low abundance and restricted range, it is highly susceptible to threats such as browsing by rabbits or macropods, trampling by stock or humans, invasion by *Callitris glaucophylla* (White Cypress Pine) and disease. Its response to fire is unknown.

To date, recovery actions have included surveying potential habitat for further populations, *in situ* monitoring and management of the population, and preliminary studies to gauge the level of genetic variation within the population. Since 1990 the Gardens has played its part in recovery by trialling propagation techniques, described in detail by McAuliffe (1996).

Initially nursery staff experienced difficulty striking cuttings and attempts were limited by the low quantity of suitable cutting material and slow growth rates. Over many years, the nursery trialled taking cuttings from different parts of the plant, at different times of the year, and using different mixtures of plant growth hormone.

After extensive trialling, a successful propagation technique was devised and more than 50 individuals are now in cultivation. The technique has included grafting cuttings onto the rootstock of the related and more vigorous *Hakea salicifolia* (Willow-leaved Hakea) to increase growth rates and hence the amount of material available. More recently the nursery has reverted to propagating the plant as cuttings without needing to graft.

The *ex situ* recovery focus for this plant has turned to securing a genetically representative population at the Gardens and, for this, it is necessary to know the level of genetic diversity in the wild population. If additional genetic variation is identified then further collections of cuttings

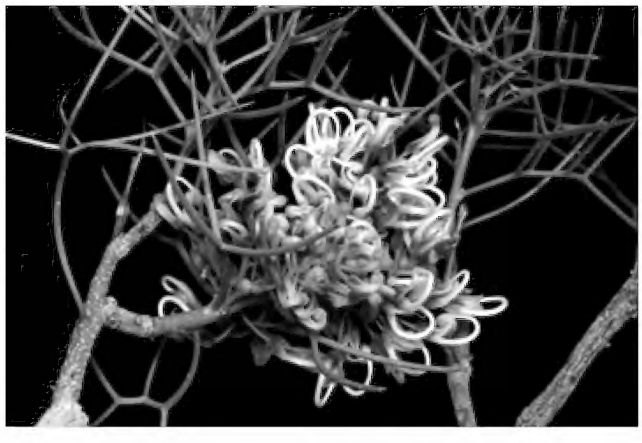

Figure 1. The endangered Hakea pulvinifera. *Photo: Murray Fagg.*

will be undertaken. In this way the Gardens is helping fulfil one aim of the recovery plan, viz. to establish *ex situ* populations of the plant, to be maintained in perpetuity.

Lepidium ginninderrense—a potential success story

Lepidium ginninderrense (Ginniderra Peppercress) is not the most beautiful plant, but it is critically endangered and attracting attention from the ACT Government and the Gardens. This perennial herb from the Family Brassicaceae is only known from one population of about 2000 plants in an area 90 m by 30 m on the former Belconnen Naval Transmission Station in the suburb of Lawson in the Australian Capital Territory (ACT Government 2003). This is also the type locality.

Figure 2. Searching for Lepidium ginninderrense *plants in its natural habitat. Photo: Joe McAuliffe.*

Its habitat (Figure 2) is temperate grassland dominated by *Austrodanthonia* spp. and *Bothriochloa macra*. It is an inter-tussock species that benefits from grazing that suppresses introduced weeds. The plant's home range is surrounded by suburbs and therein lies the key threat to its survival—urban infill and visitor or land management activities. It is listed as vulnerable under the EPBC Act and endangered under the Australian Capital Territory *Nature Conservation Act 1980*.

Unlike *Hakea pulvinifera*, this plant sets good quantities of seed which means there is potential for seed banking, *ex situ* conservation and translocation. In 2008 nursery staff at the Gardens successfully harvested seed from the wild population, grew plants to full maturity and collected more seed thus ensuring that the seed-to-seed cycle was viable.

Staff have since developed a proposal for the *ex situ* conservation of the plant based on seed orcharding. Briefly, seed orchards are a method of mass-multiplication of plants to produce large and sustainable crops of seed with minimal disturbance to the wild population. Cochrane and Barrett (2009) provide more information on the concept.

The Gardens' proposal, prepared in collaboration with key stakeholders, comprises:

- establishing an *ex situ* seed orchard on-site,
- determining the planting density which encourages the greatest seed production, and
- counting seed set, both *in situ* and *ex situ*.

Using the Gardens' expertise in seed banking, the project would establish the best conditions for seed storage, measure longevity of stored seed and compare viability and germination rates of *in situ* and *ex situ* seed collections. Other activities to support recovery would include devising methods for establishing a translocated population, raising public awareness via interpretation at the Gardens and associated media, and engaging community groups to participate in the conservation of this plant. If resources can be secured the Gardens has the expertise and facilities to undertake both orcharding and seed banking.

Conclusion

A key aim of the Australian National Botanic Gardens is to develop *ex situ* collections of plants and seed of rare or threatened taxa for use in recovery plans. *Hakea pulvinifera* and *Lepidium ginninderrense* exemplify the Gardens' success in this field and its potential to contribute. In the future, we hope to be able to report that new populations of the latter have been established in safe habitats.

Acknowledgements

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Australian National Botanic Gardens: protecting alpine plants in the face of climate change

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Introduction

Australia's alpine vegetation (see main picture, front cover) is well recognised for its scientific significance, endemism, species diversity, diversity of origins and its morphological diversity. The Australian Alps are recognised as one of Australia's 11 centres of plant diversity and one of the world's 187 biodiversity hotspots. The alpine zone is a small, single, high elevation area in a much larger, low elevation, low rainfall continental landscape, which further enhances the significance of its vegetation.

It is predicted that climate change will have a significant effect on alpine plant diversity and on the structure and function of many alpine plant communities by impacting upon their physiology and timing of life cycles, and on their interactions with other species. This will subsequently lead to the redistribution of alpine plant communities and changes in their structure and composition.

There is now documented evidence to suggest that changing climatic regimes in the Australian Alps over the past 10-20 years have already had significant impacts on the distribution, abundance, life cycles and physiology of a number of alpine plant species. Consequently the Alps biome has been identified as a priority for ecosystem, community and species-specific studies in terms of predicted climate change impacts and the responses of plant species to these changes (Australian Greenhouse Office 2005).

The alpine vegetation and climate change impacts

The predicted impacts of climate change and seasonal shift on the Alps vegetation vary with the species' life-forms, location in the landscape, sensitivity to small changes in micro-environments, dependence on late autumn and early spring snow cover, as well as changes in total and seasonal precipitation, humidity and temperature (Good 1998; Pickering *et al*. 2004).

The Alps vegetation also has high levels of biodiversity and endemism due principally to the combination of steep altitudinal gradients, the many micro-climatic sites providing a range of microhabitats, and the evolutionary origins of alpine species.

The current alpine flora reflects a long history of colonisation and speciation events. The species found at high elevations are adapted to alpine conditions including a lengthy winter snow cover. It is expected that species' capacity to migrate or to move further up the elevation range, as a response to predicted warmer climatic conditions and declining or total loss of snow, is going to be limited. Pressure to colonise a smaller area at higher altitudes will be high and competition intense in an ecosystem where the species have colonised all micro-habitats on all aspects, such that existing populations and communities historically have been relatively stable.

An understanding of the impacts of predicted and identified changing climatic factors in the Alps on the plant phenology, seed production, seed viability and longevity and seed germination of indicator species, is therefore central to developing management strategies to ensure the survival and adaptation of the alpine plant species to future predicted and increasing climate changes.

An exciting new collaborative research program between the Australian National Botanic Gardens (ANBG), Australian National University (ANU), University of Queensland, Royal Botanic Gardens Mount Annan, Centre for Biodiversity Research, Canberra and Kosciuszko National Park, is to commence in October 2009 to address these alpine seed and seedling ecology issues.

Role of the Australian National Botanic Gardens

The Gardens is the premier national organisation with a long history of growing, studying and promoting Australian native plants. Hence it can play a leadership role in studies aimed at ensuring predicted climate change does not lead to extinctions of native plant species and communities.

In their recent report on the impacts and management of the implications of climate change, Hyder Consulting (2008) noted that the Gardens is 'ideally placed to respond to this challenge and may play an increasingly important role in *ex situ* conservation'.

Goal 3 of the *National Strategy and action plan for the role of Australia's botanic gardens in adapting to climate change* (CHABG 2008) is 'to establish a long-term monitoring program of plant responses to environmental change'. The focus of this goal is 'To monitor the effects of climate change across Australia's wide variety of ecosystems using the established network of botanic gardens across Australia'. The strategy further states that the Gardens has significant expertise and knowledge of plant flowering and seasonality studies and is well placed

Figure 1. Checking plant identification prior to collecting seed samples. Photo: ANBG/David Taylor.

to develop methodologies for monitoring the impact of climate change. Goal 4 of the strategy—'to increase national community awareness of climate change and facilitate effective responses'—gives further support to the Gardens' role in climate change studies and has specifically been built into the aims of the project (see below).

The Gardens is ideally located to undertake phenological and seed germination trials of alpine species and the subsequent growth of *ex situ* plants for further morphological and genetic studies. Its staff have already collected seed of some 80 alpine species (Figure 1) and are well placed to commence germination and seed viability studies, as well as the storage of a seed reserve for use in the event of species decline or at worst, species extinctions in the Alps.

Gardens staff already have a close working relationship with management and research personnel in the project's partner institutions. The Gardens thus is in an ideal situation to co-ordinate the initial collaborative alpine seed viability and germination trials, *ex situ* plant conservation studies and *in situ* field plantings for climate change/plant morphology studies, with these institutions.

Seed and seedling ecology project

Currently, there is little knowledge or appreciation of the resilience of alpine plants and plant communities to changes in climatic regimes and seasonal shifts in weather conditions. The purpose of this new collaborative project on seed and seedling ecology is to use detailed ecological and genetic analysis to identify a range of alpine species that may act as indicator species in the Australian Alps, and to determine the impact of future climate change on alpine species and communities.

The project is to commence in October 2009 and will support an ARC postdoctoral fellow program based at the ANU and ANBG and working in collaboration with other partners. The project will also involve post-graduate and honours student research programs. The project will receive funding from a Commonwealth ARC grant and from the Friends of the ANBG, and additional support from the participating organisations. The Friends of the ANBG will also contribute to field activities and assist with laboratory studies.

Links have been established with the Millennium Seed Bank in the United Kingdom to which alpine seed will be supplied for long-term storage.

The aims of the project are:

1. To investigate the germination and dormancy patterns of alpine plant seeds and determine how germination methods can be enhanced; whether physiological dormancy is prevalent among alpine seeds and whether mimicking natural alpine environments can alleviate this dormancy in alpine seeds. This will enable protocols to be developed for the propagation of alpine plants *ex situ*.
2. To investigate variation in quality and longevity of seeds from alpine plant species in order to optimise protocols for their *ex situ* conservation.
3. To determine how seed production, seed quality, seedling vigour and recruitment in common alpine species vary along a natural altitudinal gradient and how these traits will be affected by climate change.
4. To assess the role of the maternal environment in determining alpine seed quality, germinability (including dormancy status) and seedling vigour under current and predicted alpine climatic conditions.
5. To develop outreach and interpretive materials including an alpine garden showcasing results and providing opportunity for the general public to learn more about the ecology and management of the Australian Alps flora.

Studies into the maternal effect of environmental factors such as ambient temperature, soil moisture and UV radiation upon seed set, quality and germination will make use of facilities at CSIRO and ANU. The propagation of plants for *ex situ* conservation and field plantings for *in situ* plant morphology and growth studies will be carried out at the ANBG nursery.

To compliment the project the Gardens will feature a publicly accessible display and interpretive element as the shopfront for the work. This will be a tool for connecting and engaging people with this and similar projects and more broadly with biodiversity and climate change.

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New generation botanic garden: Mount Annan

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Introduction

Mount Annan Botanic Garden is large in size (416 ha of green space) and a place with big plans. This young, wholly Australian plants garden of the Royal Botanic Gardens Sydney is fast becoming the best example of a new generation of botanic gardens, i.e. a balanced hub of science, sustainability and recreation. About to turn 21 in October, its youthfulness provides many opportunities—a fresh, clean canvas with a basic framework in place.

The Garden is a wonderful recreational resource with spectacular horticultural displays and a scientific research reputation that is well respected. At the heart of that research and conservation collection is the NSW Seedbank. The SeedQuest NSW project, partnered with Kew's Millennium Seed Bank, over the past five years has largely contributed to 37 per cent of New South Wales seed bearing plants and over 30 per cent of the state's threatened flora currently being held in this repository.

Rainforest Seed Project

Complementing that work, the Rainforest Seed Project, led by Dr Kim Hamilton, is focussing on new technologies to store and conserve rainforest seeds. Australian rainforests cover only 0.3 per cent of the land but contain more than 50 per cent of the plant biodiversity of Australia.

Traditional seedbank techniques involve drying and storage at low temperatures and humidity. Not all species can survive desiccation, particularly rainforest species which are considered desiccation intolerant. The Rainforest Seed Project aims to understand how rainforest seeds germinate and grow; screen species to determine whether or not they can be stored by conventional seedbanking; and store the seed if it tolerates drying or conduct further research to identify the best alternate method of conservation. Typically this would involve developing tissue culture and cryostorage (low temperature) techniques.

Plant germplasm conservation

Yet another extension of the SeedQuest NSW project has been the collaboration with other Millennium Seed Bank partners in Australian Seed Conservation and Research (AuSCaR). The Australian Network for Plant Conservation in partnership with AuSCaR has just published a book on plant germplasm conservation in Australia to provide strategies and guidelines for developing, managing and utilising *ex situ* collections.

Cathy Offord, who is based at Mount Annan, is the book's co-editor, and she and other Mount Annan staff have contributed articles to it. With the other contributors they place conservation of this country's unique and varied plant life in a national and international context, outline the key conservation treaties and strategies, and provide a practical knowledge kit for programs requiring germplasm collection, storage, research and utilisation. The contribution of Mount Annan staff draws heavily on their practical experience from germplasm work at this Botanic Garden.

Big Idea Garden

While a range of plant selection trials continue in the Garden, one of the theme gardens at Mount Annan has had a makeover with sustainability and conservation in mind. Once called the 'Bottlebrush Garden', it is now the 'Big Idea Garden' (BIG). Its primary purpose is to provide people with simple, practical approaches to developing their own waterwise gardens and to be aware of recycling and reuse opportunities. While most plant displays elsewhere in the Garden are wild sourced, the BIG showcases cultivars of Australian plants so that visitors can make informed purchases for their own gardens. This is an attempt to educate visitors about available plant alternatives and practical suggestions about reducing their environmental footprint.

War on the African Olive

Cumberland Plain Woodland remnants comprise about 71 ha of the Mount Annan Botanic Garden estate, of which 40 ha is good quality and the rest in medium condition. For over two decades the Woodland's ecology has been assessed and regeneration trialled. Presenting more of a challenge is the poor condition Woodland and African Olive forests which comprise a further 75 ha. African Olive seedlings, spread by local bird species, continue to appear. A range of controls have been trialled, from mechanical removal by very large machinery to basal spraying, drilling and injection. Fortunately, research has established the African Olive seed is viable for only 2-3 years in the soil. Over the next five years large tracts of the Olive will be removed.

Because African Olive totally shades the soil surface, once removed, viable seed germinates. To reduce invasion by it and other common weeds, plus labour intensive follow-up, mechanical removal will focus on the heart of nominated hubs, while retaining a protective perimeter. This should act as a barrier to windblown seed, while the Olive trees will provide valuable mulch to subdue germination. Seed from local grasses has been collected and grass seed production for revegetation activities is underway.

Bicentenary Project—PlantBank

The oldest botanic garden in Australia—the Royal Botanic Gardens Sydney—will celebrate its bicentenary in 2016. Mindful of the Botanic Gardens Trust's stewardship and commitment to sustainability, assuring future viability of its three botanic gardens (Sydney, Mount Annan and Mount Tomah) for future generations has determined targeted infrastructure projects.

The flagship bicentenary project planned for Mount Annan is construction of PlantBank. Instead of the current ageing and temporary facilities of the NSW Seedbank, this new building will be a state of the art scientific research and collection facility. It will have the spatial, functional and technical capacity to support the programs associated with the Seedbank.

The new facilities are planned on a modest scale but allow for future expansion. Horticulture, systematics, plant ecology and plant disease research facilities will be integrated through a purpose built facility which will include laboratories, controlled environment rooms, incubator rooms, growth rooms, offices, teaching space and a conference facility. Climate controlled research glasshouses are planned on an adjacent site.

The facility has been designed to encourage visitor interaction and engagement with conservation science through viewing areas. The Seedbank design is based on ecologically sustainable principles and will be housed underground in controlled environment rooms at -18°C with capacity for storage to year 2040.

Funding support will be sought from a range of sources. The value of this conservation centre will be widely appreciated. When built, it will make a significant contribution to the capacity of the Botanic Gardens Trust to undertake scientific research, securely house the New South Wales Seedbank collection and provide formal and informal education and training programs.

Conclusion

Mount Annan Botanic Garden is contributing to plant conservation in many ways. With its natural vegetation, established research, horticultural and education bases, growing numbers have the opportunity to not only share recreational facilities. Visitors (and staff) can also passively and actively learn about plants and the local environment. Future developments like PlantBank will exponentially grow this potential. Committed, hard working staff who are always full of ideas, will continue to contribute to an exciting phase of plant conservation at the Garden, through expanded displays, facilities, research output, seed storage capacity, skills development and education programs.

Research on Alpinia caerulea *(Native Ginger) growing at Mount Annan has shown it to have desiccation tolerant seeds. Photo: K. Hamilton.*

Conservation partnerships in the Red Centre: Olive Pink Botanic Gardens

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Olive Pink Botanic Garden

Olive Pink Botanic Garden is situated on the banks of the Todd River, Alice Springs in the Northern Territory and covers an area of approximately 16 hectares. The Garden contains a collection of arid zone plants endemic to the Southern Bioregion of the Northern Territory.

Founded in 1956 by Miss Olive Muriel Pink (1884–1975), she was responsible for the site's gazettal as the 'Australian Arid Regions Flora Reserve' and was appointed as honorary curator until her passing in 1975. Olive Pink Botanic Garden was opened to the public in 1985 and has continued to blossom ever since.

The initial plantings were made in the 1950s and 1960s by Miss Pink and her aboriginal gardener, Johnny Jambijimba Yannarilyi and have been bolstered by the Botanic Gardens staff and members of the Australian Plant Society in Alice Springs who have tirelessly volunteered their time and resources. There are currently over 380 Central Australian species represented, including species that are listed as rare or threatened.

Our arid zone environment

The average annual rainfall at Olive Pink Botanic Garden is 285 mm and is generally derived from a few significant rain events in November and March. The average annual evaporation is over 3000 mm. Temperature range is extensive, with a January average maximum of 36°C (minimum 21°C) and an average of 13 days above 40°C each year. The July average minimum is 4°C (maximum 19°C) with the occurrence up to 40 frosts per year.

Soils in the garden are sandy loam to sandy clay loam and have an alkaline trend with a pH 6.5–8.5 at the surface and 7.5–9.5 at depth.

Conservation of rare and threatened species

Since 1985 annual plantings at Olive Pink Botanic Garden have included species on the register of 'Rare or Threatened Australian plants'. Our aim is to monitor the growth habits of species and continue the expansion of our living collection for conservation purposes. We currently have over 220 specimens of 33 species from 15 different families (Table 1).

As with other plantings, rare and threatened species are double labelled, i.e. with a perm-o-tag attached to the plant and an engraved aluminium stake label (25 mm x 3 mm x 400 mm) positioned in the ground. Stake labels show the botanic name and preferred common name on the front face and the plant number on the rear. Rare plants are further identified for the benefit of staff and visitors with parallel lines engraved on the top of the tag. To assist with monitoring and recording, each specimen is given a reference number at the time of planting that is used in a data base in which the history of the plant is developed.

The Australian Plant Society in Alice Springs

The relationship between the Olive Pink Botanic Garden and the Australian Plant Society in Alice Springs is strongly interwoven. Formed in 1972 as the Alice Springs branch of the South Australian Region of the Society for Growing Australian Plants, the Society has been integral in the development of the Botanic Garden.

One of the primary objectives of their first inaugural meeting was the formation of a local Botanic Garden, a vision that was realised in 1985 when the Olive Pink Flora Reserve was opened to the public. It officially became a Botanic Garden in 1997. The Australian Plant Society in Alice Springs began utilising the information centre as its new headquarters and has been holding its meetings, public forums and contributing to the gardens interpretive material ever since. Throughout the history of the Botanic Garden all permanent staff have been members of the Australian Plant Society.

Partnerships for protection

Acacia latzii (Figure 1) is a rare central Australian shrub or tree known from only two populations. One lies approximately 130 km south of Alice Springs and the other on the border with South Australia. The first specimens were collected in 1980 by Peter Latz after whom the species was named.

In 1988 the first *Acacia latzii* seedlings propagated by the Australian Plant Society in Alice Springs were planted out in the Botanic Garden. Since then we have been monitoring their growth and habits, and have expanded our collection to include multiple specimens, ranging from six months to 20 years in age.

In 1992 Mr Latz, Olive Pink Botanic Gardens Curator Clarry Smith and Grounds Manager Connie Spencer (also president of Australian Plant Society in Alice Springs) selected two suitable sites from one of the known populations to fence and closely monitor. It was noted that

Table 1. Rare or threatened species in cultivation at Olive Pink Botanic Garden, 2009.

Family	Scientific name	Common name
Acanthaceae	*Harnieria kempeana* subsp. *kempeana*	
Arecaceae	*Livistona mariae* subsp. *mariae*	Palm Valley Palm
Caesalpiniacese	*Senna artemisioides* subsp. *glaucifolia*	
Concolvulaceae	*Ipomoea polpha* subsp. *latzii*	Giant Sweet Potato
Cyperaceae	*Carex fascicularis*	Tassel Sedge
Dilleniaceae	*Hibbertia glaberrima*	Desert Buttercup
Euphorbiaceae	*Ricinocarpos gloria-medii*	Glory-of-the-Centre
Fabaceae	*Swainsona colutoides*	Bladder Swainsona
	Swainsona formosa	Sturts Desert Pea
Lamiaceae	*Wrixonia schultzii*	
Mimosaceae	*Acacia ammobia*	Mt. Conner Wattle
	Acacia desmondii	Des Nelson Wattle
	Acacia dolichophylla	Chewings Range Wattle
	Acacia grasbyi	Red Witchetty
	Acacia latzii	Tjilpi Wattle
	Acacia maconochieana	Salt Wattle
	Acacia peuce	Waddy Wood
	Acacia stipulosa	
	Acacia undoolyana	Undoolya Wattle
Myoporaceae	*Eremophila* sp. Arookara Range	
	Eremophila alternifolia	Narrow-leaf Fuchsia Bush
	Eremophila battii	
	Eremophila cordatisepala	
	Eremophila dalyana	Gidgee Fuchsia-bush
	Eremophila polyclada	Lignum Fuchsia Bush
	Eremophila prostrata	Rainbow Valley Fuchsia Bush
Myrtaceae	*Eucalyptus cupularis*	Halls Creek White Gum
	Eucalyptus lucens	Shiny-leaved Mallee
	Eucalyptus thozetiana	Thozets Box
	Melaleuca faucicola	Desert Bottlebrush
Proteaceae	*Hakea grammatophylla*	MacDonnell Ranges Hakea
Xanthorrhoeaceae	*Xanthorrhoea thorntonii*	Desert Grass Tree
Zamiaceae	*Macrozamia macdonnellii*	MacDonnell Ranges Cycad

Figure 1. Reaching up to 5 m, Acacia latzii *is similar in appearance to Gidgee (*A. calcicola*) but has smaller, greener leaves and is restricted to slopes and watercourses of small hills in gibber country. The understory is sparse and consists mainly of scattered, low saltbush and bluebush shrubs and occasional tussock grasses. Photo: P. Latz*

'although mature trees seemed to be of good health and producing seed, the occurrence of juvenile forms was very rare'. Questions were raised regarding seed viability and the impact of introduced feral species.

Both enclosures are now a part of a long-term research program. This combined with the information collected from our *in situ Acacia latzii* program has helped to paint a more accurate picture of these threatened survivors.

Into the future

The future will see Olive Pink Botanic Garden playing an important role in conservation and sustainable practices for the arid zone, through education and community engagement. We will endeavour to continue strengthening our ties with associated organisations such as the Australian Plant Society, as these relationships are essential to the longevity of publicly owned organisations. Our program to expand our living collection of rare and threatened species will continue as new species are discovered and classified in what is one of Australia's last frontiers.

Further Reading

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Eurobodalla Regional Botanic Gardens looking after *Ziera adenophora*, a south coast special

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Introduction

A number of species of the *Zieria* genus that occur in New South Wales are on the endangered or vulnerable schedules of both the Commonwealth and NSW governments. One of these is *Zieria adenophora*, or Araluen Zieria. The only known natural population of this species consists of about 56 mature plants located in a valley north of Araluen, about 16 km north-west of the coastal town of Moruya.

Zieria adenophora is a member of the Rutaceae family. It is a slight, open, erect shrub to about 50 cm high, with small opposite leaves divided into three leaflets. All parts of the plant are covered in warty structures that give off a strong, aromatic smell when crushed. Tiny four-petalled flowers (about 5 mm across) are white to pale pink, arranged singly or in small clusters in the leaf axils. The fruits are warty capsules about 5 mm across and divided into four chambers containing the seeds. It seems that during the winter, the foliage on some plants turns a deep magenta, returning to dark green as the weather warms into spring.

When James Smith, late 18th Century English botanist and founder of the Linnean Society, first named the genus from New South Wales, he bestowed upon it the generic name, *Zieria*, in honour of his friend, botanist Jan Zier, who had just died. The specific epithet, *adenophora*, comes from two words, *aden* = gland, and *ophora* = to bear, referring to the numerous warty glands on flower parts, fruit, leaves and stems.

Early collections

The species was first collected near Araluen in 1888, and again from near Araluen in 1889 and 1900 (hence the common name—Araluen Zieria). It was also collected 'near the Clyde' in 1889 and 'in some of the remotest sources of the Murrumbidgee at Maneroo' in 1888. The last two descriptions of locations are so imprecise that it would be difficult to re-locate the plants today, if indeed any are growing there. This difficulty underlines the importance of making full location notes when writing data on collected species, so that plants can be found again should the need arise.

The tiny flowers and glandular leaves of Ziera adenophora. *Photo: Helen Moore.*

Habitat

The only currently known location of the species is on the steep upper slope of a north north-west facing hillside in a shrub community on the margins of a Maiden's gum (*Eucalyptus maidenii*) low open forest. The *Zieria* grows in shallow gravelly loam among granite boulders, in a shrub community consisting of *Acacia mearnsii* (Black Wattle), *Dodonaea viscosa* (Sticky Hop Bush), *Ficus rubiginosa* (Rusty Fig), *Correa reflexa* var. *reflexa* (Common Correa), *Notelaea venosa* (Mock Olive), *Marsdenia rostrata*, *Plectranthus parviflorus* and *Poa sieberiana*.

The plants seem to flourish in either full sun or part shade that is provided by the boulders and nearby shrubs. Owing to the western aspect of the slope, conditions on summer afternoons would be extremely hot, but the cold air drainage effects of the slope and heat retention in the boulders would ameliorate severe winter cold. The hillside is exposed to strong westerly and south-westerly winds.

Eurobodalla Regional Botanic Gardens conservation action

The above site was visited in 2001 by a team from the Eurobodalla Regional Botanic Gardens, by arrangement with the Threatened Species Unit of the NSW National Parks and Wildlife Service, and a number of cuttings were taken. It was noted later that cuttings made from young plants progress better than cuttings from older individuals. These cuttings were potted into a mix of three parts sand and one part perlite. In 2005, 22 plants were planted out in the Gardens Display Gardens. Of those 22, only five survive today, all of which are sparse and straggly.

However, in 2007, a *Ziera* seedling appeared in a Display Garden where two plants had been established. The soil is coarse, rather well drained, and covered with a good layer of rough metal mulch. This seedling grew well, and was followed over a period of months by 23 more. These are presently doing well in the potting shed. Whether these self-sown plants will have a longer garden life than those grown from cuttings remains to be seen.

A member of the Gardens propagating team planted one in 2005 on her house block in a spot with similar soil structure and aspect to the original location. This plant is still alive today, but in much the same condition as those in the Gardens. She pruned it lightly to try to improve its looks, but it did not shoot below the cut, or from anywhere else. The inability to make new growth after pruning could indicate the species' sensitivity to trampling (mainly by goats at this site) and to fire. A major fire event at the Araluen location could prove disastrous to this extremely vulnerable population. It appears that this species is an obligate seeder that does not regenerate from roots or stems.

Recovery plan

The NSW National Parks and Wildlife Service (2001) has drawn up a recovery plan for *Z. adenophora* that has been adopted by both the Commonwealth and state governments. The Plan states, as a Specific Objective, that a concerted effort be made within four years to locate previously recorded populations, and that surveys of other potential habitats be conducted. The Recovery Plan was to be formally reviewed by the Service, and other stakeholders, within five years from the date of publication.

Conclusion

The long-term survival of *Z. adenophora* is problematical, given the restricted nature of the site and the fact that despite thorough searching, to date no further populations have been discovered (to my knowledge). Should the species face extinction, re-introduction into the wild, although a very labour-intensive exercise, may be possible from specimens cultivated at the Eurobodalla Regional Botanic Gardens.

Reference

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Getting the message across at Mackay Regional Botanic Gardens: flora conservation through fauna interaction

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Introduction

Located on the Central Queensland coast, the Mackay Regional Botanic Gardens (the Gardens) is one of Australia's newest botanic gardens, opening to the public in May 2003. In just six years, the Gardens is experiencing early success with *ex situ* conservation of threatened plants from the Central Queensland Coast bioregion—the central theme of this garden and the adjacent Brigalow Belt bioregion.

However an unlikely source has been a contributing factor for this success—insects! A far more visceral approach based on the Gardens' popular schools and visitor education program 'Plant*ed*' is helping distribute and conserve these threatened species, as the public discover our special plants via the fauna they attract.

The Gardens was constructed on a 51 ha greenfield site in 2001. The Lagoons Reserve was Mackay's first water supply and was also home to the fledgling town's acclimatisation garden in the late 1800s. After years of neglect and basic public space maintenance, the Society for Growing Australian Plants, Mackay Branch (SGAP) commenced naturalistic gardens on the site in 1995 as a precursor for a potential future botanic garden. Plantings represent the different forest communities of the bioregion and adjacent Brigalow Belt and threatened species were included to help boost *ex situ* populations.

When major construction of the new botanic gardens commenced the site consisted of these four SGAP gardens, 20 ha of mowed grass, some existing exotic trees, a sugar cane field and a permanent lagoon that for many years had been sprayed with herbicides to control water weeds. Over 90 per cent of the flora and fauna that would have lived at the site prior to European settlement of the area, had vanished. Through public consultation it was identified that the core elements of the site's development as a botanic gardens were re-establishing habitat and conserving threatened flora. It was then up to the fledgling Visitor Services program to start enticing the public to visit and promote the Gardens' messages on flora for fauna, research and conservation.

From our first guided educational tours in late 2003, the Gardens engaged the public on many diverse levels of interest, from architecture and design to history and cultural significance. This was especially important when virtually the entire site consisted of acres of uninspiring tube stock and several hectares of mulch! Touch, smelling and in many cases viewing the wildlife that lived at, or began returning to, the site became the cornerstone of the education program. This created relevance to the community as to what a botanic gardens actually was, as opposed to a display garden or parkland.

Early results by accident

It's a known fact that children love animals. Just about everything that moves is exciting and interesting. But unless it's a Venus fly-trap plants can seem rather dull in comparison. But Mother Nature had a few tricks up her sleeve that helped capture the attention of visitors.

One of the first plants to 'perform' by growing quickly and coming into flower was Native Plumbago (*Plumbago zeylanica*). Though not threatened in Australia, it is elsewhere and is a plant identified by Botanic Garden Conservation International as of significance internationally for medicinal purposes. This important fact was lost on the kids … but what wasn't lost was the excitement caused by the *en masse* appearance of hundreds of little grey butterflies around this plant and the fun sticky velcro-like seed capsules that stuck to socks, shirts and even the class teacher (much to the children's delight) as the children crowded in to see. *Plumbago zeylanica* is the favoured food plant for the Plumbago Blue Butterfly (*Leptotes plinius*, Figure 1) and was the first animal to make a 'noted appearance' just months after the Gardens opened. Immediately, teachers saw this interest from the children and schools began asking 'How do we get this plant for our school gardens?'.

*Figure 1. Plumbago Blue Butterfly (*Leptotes plinius*). Photo Maya Harrison.*

The second species to engage the public was Tree Omphalea (*Omphalea celata*), which is listed as threatened and is only known from a few isolated populations in Central Queensland. Previously it was thought to be a species of Candle Nut (*Aleurites* sp.), as the *Omphalea* genus worldwide consists only of vines or woody lianes.

Tree Omphalea was first planted by SGAP in their early plantings, and again appeared in the Stage 1 gardens in 2003. However both sites were over half a kilometre from the main visitor centre. As Mackay struggled through to the end of a ten-year drought in 2005 that saw rainfall halve, staff noticed this plant's ability to conserve moisture in fat, fleshy carrot shaped roots and grow in sandy, rocky and shallow soils. As a result, a grove of 15 young trees was planted just metres away from the main arrival point, to promote wise water usage and add more of this threatened species to the Garden's living collection.

Plant it and they will come

What happened next took the lessons learned with *Plumbago zeylanica* to a new level. The Zodiac Day Moth (*Alcides metaurus*, Figure 2) is a very large and conspicuous day-time flying moth. The larva feeds on euphorbiaceous vines or trees and in the Mackay region, *O. celata* is a larval food plant.

Two years after planting the new grove, the first of the Zodiac moths were seen at the visitors centre. By spring 2008, hundreds of these large, showy moths flitted around and captured the attention of all visitors.

More seed was collected and grown, more plantings of *O. celata* have been added through the site to 'spread' the moth, and just this week, five seedlings are being provided to Eungella State School for their 'Butterfly Garden'. This school is particularly significant as it is located less than 30 km 'as the crow flies' from one of the natural occurrence sites for *O. celata*, potentially creating a wildlife corridor.

Here was a key link to assist with conservation of some threatened species in the community and create relevance to our wider conservation programs. In any botanic garden, there's only so much space available and there can also be the danger of having the only *ex situ* repository of certain species, especially those that are important food plants. Some species at the Gardens have been too successful at attracting insects, to the point of almost killing the plant with repeated larval 'infestations'. And for the public, if it's not 'spectacular' with flowers or fruit, it's potentially not interesting.

*Figure 2. Zodiac Day Moth (*Alcides metaurus*) with eggs. Photo: Maya Harrison.*

If schools and the public are interested in these wildlife attracting species, what others could be identified to take the *ex situ* conservation message further? Planting could occur at schools and even Council managed parks, becoming *ex situ* annexes for threatened species endemic to their own areas.

Of course, this is a side-step from the importance of conservation, and some threatened species would go to an early grave if planted in a school of public park. Plant conservation is also not just about what's 'pretty' or 'wildlife attracting'. But for those species that perform well outside of whatever constraints occur in its natural distribution, it is another avenue for *ex situ* conservation to explore and creates links between a conservation program and the community.

Threatened species a vital element in Tondoon Botanic Gardens, Gladstone

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History

The Gladstone Tondoon Botanic Gardens is an all native botanic garden situated at the edge of Gladstone City on the Central Queensland coast. Tondoon consists of 21 ha of established collection surrounded by 150 ha of bushland. Development having started in 1981 was well under way at the official opening in 1988.

Display beds have been set out mostly in geographical and ecological areas. The geographic areas are generally state forests or now national parks. Ecological areas are collected from the many small pockets of rainforest scattered throughout the region. Being on the coast, Gladstone has a very humid climate and shallow clay soils. Because of this we have had difficulty growing plants from different soil types such as granite or sand and also from the drier climate areas on the western edge of our region. Consequently Tondoon's display is primarily rainforest species.

The Primary Display area encompasses plants from our Port Curtis Pastoral District, which is mostly coastal but incorporates a varied range of ecosystems. Higher altitudes, cooler climate and large rainforest areas of the ranges give an interesting variation to more humid coastal forests.

Ex situ collection

Tondoon staff and volunteers collect propagules locally for the Primary Display, so they are all from known provenance. Material collected is propagated in our nursery and we often have a selection of threatened species there from our existing collection. We have found that a large majority of the threatened plants are easy to propagate and plants in the gardens self propagate quite readily. This often brings up the question of why are they now threatened? Increasing community awareness of threatened plants is an important priority at Tondoon, so we use the plants from this nursery selection to give away at available opportunities.

Extended on from this Port Curtis area is a collection of south-east and north-east Queensland rainforest plants. Plants in the former area predominantly came from Hugh and Nan Nicholson when they owned Terrania Creek Nursery in northern New South Wales, while plants in the north-east Queensland beds came from the Radke's at Yaruga Nursery, Walkamin. These plants were obtained in the 1980s to early 1990s and a number of them turned out to be threatened species.

The threatened species collection started off with the new plant discoveries we were making in the early 1980s. This came about from the lack of previous flora surveys in our region. Creating a new botanic garden and making new plant discoveries made this an exciting time for us. Most of these discoveries were plants new to the Port Curtis region list. We have found 38 to date and many of these are threatened species. New species came along less frequently but were far more interesting, with some of these being useful landscape plants also. In all we have found 12 new species.

Eventually in 1991 we created a display bed for the Port Curtis Rare and Threatened Plants, which now has a total of 42 species. These same species had already been incorporated amongst the developing live collection.

Parsonsia larcomensis, *a vulnerable species discovered by Norm Gibson. Photo: Brent Braddick.*

In 1993 Queensland National Parks and Wildlife along with the Central Queensland University were working on a threatened species plant project. During the process of this project they needed help in the propagation of plants they were working with. From the material they gave to us we successfully propagated nine Port Curtis plants and 18 south-east Queensland plants. This was a significant addition to the Tondoon threatened species collection, all of which are from natural and known provenance.

Education

Environmental education and interpretation are vital elements in Tondoon's operation. We have an efficient volunteer program for assisting visitor services and education. Education through community members teaching the community can be a very effective method. Our education program consists of 15 environmental lessons, of which most are conservation orientated. We are reaching an average of 4000 school children per year through our lessons in the garden. These lessons are Queensland Education curriculum-based and are for Prep School to Year Eight. A close association with the Boyne Island Environmental Education Centre also gives us extra opportunities to teach a conservation message.

Translocation/relocation

Currently the Main Roads Department is realigning the Dawson Highway over the Biloela Range. Unfortunately there is an extensive amount of the endangered *Cycas megacarpa* within the new road footprint that are required to be translocated prior to development. Tondoon and Gladstone regional Council staff have been contracted to conduct this translocation. The project requires excavating the cycads from some rather steep country and moving them to a new site approximately 500 m away. There are approximately 500 Cycads to move and each one has been GPS mapped and photographed prior to moving. On relocation they have been positioned with an aspect and direction as close to the original site as possible. So far we have moved about 50; it's a slow process and there's a long way to go.

Another translocation project we are presently working on is for the Gladstone Ports Corporation in alliance with Aurecon Hatch. This project involves growing 80 000 plants from an island that the Ports Corporation is levelling for a wharf facility. Wiggins Island has the last remaining Littoral Vine Forest in the Gladstone city area. New temporary nursery facilities are needed for growing these plants as the project will last at least two years before planting out. There are several orchid species to be collected and once grown, all plants will be relocated to a new coastal site for preservation. This plant community is extremely important to our local area and we are pleased to be able to preserve it in some way.

Conclusion

Plant conservation is a priority at Tondoon as it should be with all botanic gardens. At Tondoon we have had the opportunity to conserve local flora—especially threatened species—more than most. Recording the known provenance has been important to us, even for common species, and may become even more significant in today's climate as the number of threatened species increases.

The Council of Heads of Australia's Botanic Gardens: working together now and for the future

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Introduction

The Council of Heads of Australia's Botanic Gardens (CHABG) is not only a fear-some acronym, it represents the leadership of some of Australia's most popular and significant public institutions, the capital city botanic gardens of Australia.

Botanic gardens are among the most frequently visited cultural sites in Australia—over 14 million Australians visit them at least once every year. They are complex and multi-faceted institutions, which are about inspiring the appreciation and conservation of plants; engaging and educating the public about conservation, sustainability and climate change; undertaking significant scientific research; and providing valuable space for recreation and relaxation and spiritual renewal in an age of increasing urbanisation and frenetic lifestyles. People interact with them in different ways but are often unaware of all their aspects. One of the key ongoing roles of the Council is raising awareness of botanic gardens and what they do and can mean to their communities.

Council members consist of the Directors of each of the state and territory capital city botanic gardens including the Australian National Botanic Gardens (Canberra), Botanic Gardens of Adelaide, Alice Springs Desert Park, Kings Park and Botanic Garden (Perth), Brisbane Botanic Gardens, Royal Botanic Gardens Melbourne, Royal Botanic Gardens Sydney and the Royal Tasmanian Botanical Gardens (Hobart). The Secretariat currently sits in the Australian National Botanic Gardens, with that Gardens' Director being the current CHABG Chair until March 2010.

Purpose of CHABG and its early achievements

The Council reviewed its purpose in 2009 and agreed that its role is to provide a forum for capital city botanic gardens to share information and to discuss and coordinate strategic initiatives for their mutual benefit and that of their communities.

CHABG was first convened in 1989. Its early achievements included a Census of Plants in Australian Botanic Gardens in 1992, the first attempt to bring all the collections information of botanic gardens together, and a survey of botanic gardens usage in 1994. More recently it has maintained a directory of Australian Botanic Gardens and Arboreta.

In 2004 the Council facilitated the inception and establishment of Botanic Gardens of Australia and New Zealand (BGANZ) Inc. as an independent body to represent the interests of all botanic gardens in Australia and New Zealand, to promote their interests and activities generally and enhance the state of botanic gardens for the benefit of the community. BGANZ now has a membership of 70 across the two countries, including four recognised regional groups (Queensland, New South Wales, Victoria and New Zealand). It also has a website (www.bganz.org.au/about.html), regular newsletter and runs a biennial conference.

The climate change strategy and action plan is the first strategy prepared by CHABG.

CHABG and climate change

CHABG came of age in November 2008 when it had its strategic approach to climate change, the *National Strategy and Action Plan for the Role of Australia's Botanic Gardens in Adapting to Climate Change* (Council of Heads of Botanic Gardens 2008) endorsed by all of Australia's natural resources and environment Ministers.

The key roles for botanic gardens identified in the Strategy are:

- providing a safety net through *ex situ* conservation,
- providing knowledge and expertise about plants to support climate change research and monitoring, and
- providing a key opportunity for increasing community awareness about climate change.

The Ministers' approval of the Strategy is a milestone for botanic gardens as it represents the first broader government acknowledgement of the sector as a whole and its important role in conservation. However, as well as increasing the profile for gardens it has also brought increased accountability, CHABG now being required to report to the Ministerial Council on progress with the strategy.

The Strategy was also endorsed by BGANZ in December 2008 and now represents a clear vision of the role of all gardens, large and small, in relation to climate change.

Implementing the Climate Change Strategy and Action Plan

Some of the key actions identified in the Strategy were that CHABG could significantly contribute to biodiversity conservation by facilitating development of a nationally coordinated approach to seed banking and research, and the improved integration of seed banking with on-ground restoration. This has resulted in the Council taking a leading role in developing the Australian Seed Bank partnership.

Australian Seed Bank Partnership

The Partnership will build on the work of Australian Seed Conservation and Research (AuSCaR) and provide national focus and coordination for seed banking for both conservation and restoration. It brings together 17 partner institutions: state government environment agencies, botanic gardens, universities and non-government organisations, including Greening Australia. The Partnership seeks to:

- provide targeted and coordinated *ex situ* conservation of plant genetic material,
- build knowledge and capacity through targeted research and development activity,
- underpin the delivery of successful and resilient habitat restoration and rehabilitation projects, by integrating the seed collection efforts and knowledge about plant establishment of seedbanks around Australia with the capacity building and on-ground delivery expertise of Greening Australia and other potential partners, and
- actively engage a broad range of partners and investors.

Education and living collections

In April 2008 education and public programs staff from member gardens of the Council held a workshop to work towards a national approach to climate change education in botanic gardens. A national program is still being developed, but as an interim measure some key common messages were agreed to be implemented by all gardens.

The Council is still exploring bringing together, into a single data set, all the information about plants which is stored in its living collections, as the exercise which was undertaken in 1992 is now out of date. Information technology has moved on considerably since then and it should now be possible to create a 'virtual national collection' accessible through the World Wide Web, using Australia's Virtual Herbarium (<www.cpbr.gov.au/chah/avh/index.html>) as a very successful working model. However this is an ambitious undertaking which will require considerable resources and remains a goal for the future.

Reference

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Australian Plant Census: August 2009 update

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The Australian Plant Census is a project aimed at providing an up-to-date list of currently accepted names for the Australian vascular flora, both native and introduced (see *Australasian Plant Conservation* 16(1): 20).

New families treated

Progress on the project has continued, with a number of additional families now treated, including the large and diverse Rutaceae. Many of the genera in this family have been the subject of recent taxonomic work, often with significant taxonomic and nomenclatural changes as a result. For example, three revisionary treatments have been published for *Zieria* since 2002, with numerous new taxa and name changes. Myriad informal names have been applied to *Zieria* species over decades, with phrase names coined for species A–Q and 1–15. However, the same phrase name was often used for different entities in different states or regions. For example, '*Zieria* species 1' referred to three taxa: *Z. verrucosa* in Queensland, *Z. baeuerlenii* in New South Wales and *Z. oreocaena* in Victoria. The Census provides a single data source covering all the changes and new information for this family.

Another important group recently treated is the Amaranthaceae, in particular *Ptilotus*. Existing *Ptilotus* taxonomy, based on the work of Gerhard Benl, was characterised by numerous infraspecific taxa (i.e. subspecies, varieties and forms) often at multiple ranks within a species. Recent revisions by Australian workers have greatly simplified the taxonomy of the genus, with, in some cases, up to eight infraspecific names being subsumed into a single species.

The non-eucalyptoid Myrtaceae are also currently being treated for the Census with numerous generic realignments reflected, such as the much reduced circumscription of *Babingtonia*, and the recognition of new genera, including *Kardomia* and *Sannantha*. Also reflected is the considerable activity of Western Australian botanists on *Baeckea* and its relatives, with numerous new and resurrected species and genera in this group.

The Poaceae is also nearing completion. Some large and important genera have been treated, including *Aristida*, *Austrodanthonia* and its allies, *Austrostipa*, *Poa* and *Triodia*, as well as numerous weedy genera such as *Avena*, *Bromus* and *Vulpia*.

Reconciling names in northern Australia

The Census was bolstered by a recent grant from the Heritage Division of the Department of the Environment, Water, Heritage and the Arts, aimed at reconciling taxonomic and nomenclatural issues for various taxa in conservation reserves across northern Australia. Families of particular interest to the Department included the Euphorbiaceae and Lentibulariaceae. While the Lentibulariaceae (comprising only the Bladderwort genus *Utricularia*) was relatively straightforward, the euphorbs have proved quite the opposite. We have nearly completed compilation of the Euphorbiaceae, which will include such widespread genera as *Bertya*, *Beyeria*, *Chamaesyce*, *Euphorbia*, *Phyllanthus*, *Ricinocarpos* and *Sauropus*.

Family planning

Another component to the Census project is the 'Family Planning' exercise, covering development of an agreed list and arrangement of taxa at the family level and above. This project commenced in mid-2008, with Terri Weese compiling agreed family circumscriptions for all flowering plants and gymnosperms. Meredith Cosgrove has recently taken over the Family Planning role, following Terri's move to another position within CSIRO, and has compiled family circumscriptions for the pteridophytes (ferns) and their allies. Meredith is also developing a full classification from Kingdom to Family level, including all relevant intermediate ranks.

Where to get the latest information

Of the groups mentioned above, data for the Amaranthaceae, Lentibulariaceae, Rutaceae and part of the Poaceae (tribes Arundineae, Amphipogoneae, Danthonieae, Aristideae, Eriachneae, Pappophoreae, Triodieae and Cynodonteae) are available via the Australian Plant Census search interface at <www.anbg.gov.au/chah/apc/index.html>.

Non-eucalyptoid Myrtaceae and Poaceae tribes Phareae, Nardeae, Stipeae, Meliceae, Brachypodieae, Bromeae, Triticeae, Aveneae, Poeae, Bambuseae, Oryzeae and Ehrharteae are available as PDFs at <www.anbg.gov.au/chah/apc/families-treated.html>.

A full listing of all other families and groups treated for the Census is available at <www.anbg.gov.au/chah/apc/index.html>. For other groups (e.g. Euphorbiaceae and the remaining tribes of Poaceae), including higher-level classification, data is not yet available electronically. The list of families treated for the Census (see link above) is updated regularly and these groups will be added as soon as the data is uploaded—keep checking for progress.

As always, the Australian Plant Census team welcomes feedback, queries and comments—you can contact us at Brendan.Lepschi@csiro.au and Anna.Monro@csiro.au.

ANPC in the USA: directions in science and conservation at the Smithsonian Institution

Zoe Smith

Smithsonian Environmental Research Center, Maryland, USA. Email: smithz@si.edu

Introduction

In July 2009, I moved to the East Coast of North America to undertake a two-year postdoctoral fellowship at the Smithsonian Environmental Research Center. In addition to seeing the sights and doing some research, as an ANPC Committee Member I'll be taking the opportunity to provide updates on the highlights and directions in science and conservation in the USA, promote ANPC on an international scale and develop links with international conservation organisations. In this report I will mention some of the highlights of my trip so far, including the wildlife and weather in Maryland, inside knowledge of science at the Smithsonian Institute, and some prominent research and conservation news.

My research

My research will focus on the dynamics of partner choice in mycorrhizal symbioses between orchid roots and soil fungi. Terrestrial orchids are dependent on associations with particular fungi throughout their life cycles, so knowledge of the diversity and specificity of associating fungi is essential for developing successful conservation programs. I will investigate the range of fungi that associate with species in the genus *Platanthera* (Fringed Orchids) in eastern North America, and use novel methods to determine whether orchids have the ability to 'choose' the fungi that they associate with. Therefore, there may be somewhat of an 'orchid bias' in these reports.

Wildlife and weather on the Chesapeake Bay

As winter comes to a close in the southern hemisphere, summer is beginning to cool down in the United States. The pyrotechnic display of fireflies is dimming and the squirrels are starting to gather acorns in bulging cheeks. The humidity still has a hold but it's difficult for an Australian to complain about the regular summer rain.

Thankfully, the flowering season is not quite over and there are still a few orchids in bloom. The peat bogs of Pennsylvania and the forests of the southern Appalachian Mountains have provided fantastic opportunities for photographs and of course research. While the bear repellent hasn't had to come out yet, the fashion stakes certainly have.

Botanists can be easily identified by their trend of tucking socks into trousers to keep out the rampant poison ivy and ticks. Unfortunately this doesn't keep the biting flies out and the wasps have no trouble getting through cotton! Still, the luminescent comb jellies (ctenophores) in the marine ecology lab, the bird life on the bay and finding out that chipmunks aren't Hollywood folklore make it all worth it. I admit that the first time I saw a ground hog I momentarily thought 'it's a wombat!'

Canoeing on the river and helping researchers electro-shock worms out of the ground have also been highlights.

Science at the Smithsonian

The Smithsonian Environmental Research Center is located in Edgewater, Maryland, on the gorgeous Chesapeake Bay (about 40 km east of Washington DC). The network of rivers and tributaries provide diverse habitats for marine research and the surrounding forest is decorated with flagging tape and creative experiments set up by soil, forest and mycorrhizal ecologists.

Platanthera blephariglottis, *an orchid native to eastern North America. Photo: Zoe Smith.*

Established in 1964, there are now 17 laboratories at the Center, with various ecological research programs including the longest running field experiment on atmospheric increase in carbon dioxide (CO_2) and the world's largest team analysing mangrove forests. Several postdoctoral fellowships are offered every year, and this year 30 undergraduate students undertook summer internships. There is also an active education and outreach centre, with programs for visitors and school children including guides hikes, evening lectures, school holiday programs and magical sunset canoe trips.

Research and conservation highlights

The most recent edition of *Legacy*, the quarterly bulletin of The Nature Conservancy, included an interesting article about protecting northern Australia's diverse wilderness. The article highlights the importance of partnerships in the success of conservation programs and provides an example of how collaboration among the Conservancy, Bush Heritage Australia and the Wills family has resulted in the purchase of a 20 000 acre property in northern Australia for protection of the diverse ecosystems and rare species that exist in the area. The Nature Conservancy has had a surprising involvement in the conservation of the Australian landscape, helping partner organisations acquire approximately 3.5 million acres of property for conservation management. More information can be found at <www.nature.org/Australia>.

Other major events include:

The Ecological Society of America held their annual meeting in Albuquerque on 2-9 August, 2009, with the theme 'Ecological Knowledge and a Global Sustainable Society'. The meeting focused on the requirement for greater connection between ecological knowledge and application in sustainable planning (see www.esa.org/albuquerque/).

Botany and Mycology, the joint annual meeting of the Mycological Society of America, American Bryological and Lichenological Society, American Fern Society, American Society of Plant Taxonomists, and Botanical Society of America, was held in Snowbird, Utah, from 25-29 July 2009 (see www.2009.botanyconference.org/emailz/index.php).

An exhibition entitled 'Dig it! The Secrets of Soil' has opened at the Smithsonian National Museum of Natural History in Washington DC. The exhibition uses interactive displays, hands-on models, videos and soil samples to emphasise the importance of soil as a resource for life on Earth (see http://forces.si.edu/soils/).

Smithsonian Education will hold a virtual or online conference from 29 September to 1 October, addressing the global challenge of climate change (see www.si.edu/).

Other scientific highlights include the development of a new algorithm that may be used to predict future changes in plant populations and how ecological factors such as climate change, invasive species and habitat stability influence plant communities (*American Journal of Botany* 96: 1430-44). Researchers have also discovered a novel lichen-associating cyanobacteria (*American Journal of Botany* 96: 1409-18) and that increases in the number of chromosome sets (ploidy level) in plants is a more important mechanism in plant speciation than previously thought, concurring with up to 15 per cent of angiosperm speciation events (*Proceedings of the National Academy of Sciences* 106: 13875-9).

On a wackier note, a recent paper discusses the possibility of a zombie attack causing the collapse of civilisation. Researchers in Canada developed a mathematical model based on the spread of infectious diseases to show that if a zombie 'plague' were to break out, humanity's only hope would be to tackle the outbreak as fast as possible using the only method that prevents zombie resurrection—decapitation. Look out for updates in the post-Halloween edition of APC!

Science and conservation networks in the USA

Further information on what's happening in the USA can be found at:

- Natural Resources Conservation Service: www.nrcs.usda.gov/
- The Nature Conservancy: www.nature.org/
- Smithsonian Institution: www.si.edu/
- Smithsonian Environmental Research Center: www.serc.si.edu/
- Smithsonian Science: smithsonianscience.org/

Report from New Zealand Plant Conservation Network

Bec Stanley

Email: rebecca.stanley@arc.govt.nz

Ecosourcing

The practicalities of ecosourcing are a current hot topic of debate amongst our members. In NZ the term is used to describe collecting native seeds close to the location of the restoration site, in amounts that reflect local patterns. The logic behind ecosourcing is that without the benefit of genetic information this method is a proxy to preserve natural ecological and genetic patterns. The method is easy to follow for small projects with their own nursery. At larger scales, e.g. where an agency with centralised nurseries supplies many sites or for restoration groups which do not have their own nursery, this is more challenging. How do you guarantee plants you buy are ecosourced? Who sets ecosourcing standards for nurseries to adhere to? What if the area you are restoring has no local native remnants for seed collection? How local is local? Does ecosourcing lead to inbreeding?

Questions like the above are being debated in our newsletter and we have decided to use this as a theme for our upcoming AGM. We will discuss the potential role NZPCN has nationally with regards to ecosourcing best practice and standards. As an aside, considering this is an Australian publication, ecosourcing seems to be a peculiarly NZ term coined by NZ botanist Eric Godley in 1972 for a practice widely used and generally accepted internationally.

Website & newsletter

Our website upgrade is almost complete. We have been actively enhancing the site 'behind the scenes' by changing our web hosting and web designer, and building new features into the site which will be released soon. The new site will have improved search engines, e.g. one search to find native and exotic vascular plant species at the same time, as well as an on-line forum for members to use to discuss plant conservation issues and an on-line payment system. Our newsletter *Trilepedia* continues to be released monthly (see <http://www.nzpcn.org.nz/documents/Trilepidea-68-090718b.pdf>). It is packed with stories from members on anything from local restoration projects, to updates from botanical gardens and threatened plant recovery.

Draft strategy

We have sent out the draft of our first NZPCN strategy to members for their comments. This document has been prepared by the Network Council using information from workshops held at last year's conference. The strategy is based on the targets of the *Global Strategy for Plant Conservation*. We have asked that members identify what they think should be the top five priorities for the NZ Plant Conservation Network for the next five years. We intend to release a final strategy shortly.

Research Roundup

Compiled by Kirsten Cowley, Centre for Plant Biodiversity Research, Canberra.

Bedward, M., Ellis, M.V. and Simpson, C.C. (2009). **Simple modelling to assess if offsets schemes can prevent biodiversity loss, using examples from Australian woodlands.** *Biological Conservation* 142(11): 2732-42.

Benson, J.S. (2008). **New South Wales Vegetation Classification and Assessment: Part 2 Plant communities of the NSW South-western Slopes Bioregion and update of NSW Western Plains plant communities, Version 2 of the NSWVCA database.** *Cunninghamia* 19(4): 599-673.

Fensham, R.J., Fairfax, R.J. and Buckley, Y.M. (2009). **An experimental study of fire and moisture stress on the survivorship of savanna eucalypt seedlings.** *Australian Journal of Botany* 56(8): 693-697.

Gibson-Roy, P., Delpratt, J., Moore, G. and Hepworth, G. (2009). **Does diversity influence soil nitrate, light availability and productivity in the establishment phase of Australian temperate grassland reconstruction?** *Ecological Management & Restoration* 10(1): 41-50.

Gooden, B., French, K, Turner, P. and Downey, P.O. (2009). **Impact threshold for an alien plant invader,** Lantana camara **L., on native plant communities.** *Biological Conservation.* 142(11): 2631-41.

Gorrod, E.J. and Keith, D.A. (2009). **Observer variation in field assessments of vegetation condition: Implications for biodiversity conservation.** *Ecological Management & Restoration* 10(1): 31-40.

Green, J., Reichelt-Brushett, A. and Jacobs, S.W.L. (2009). **Re-establishing a saltmarsh vegetation structure in a changing climate.** *Ecological Management & Restoration* 10(1): 20-30.

Groom, P.K. and Lardner, T.D. (2009). **Seedling growth responses of** Banksia littoralis **and** Melaleuca preissiana **to soil salinity.** *Journal of the Royal Society of Western Australia* 92(1): 1-4.

Harris, S., Shaw, J. and Crane, N. (2009). **Planning the integration of** ex situ **plant conservation in Tasmania.** *Cunninghamia* 11(1): 123-30.

Heyligers, P.C. (2009). **Formation of, and succession on,** Atriplex cinerea**-induced dune ridges in the Entrance Point Scientific Reference Area, Wilsons Promontory National Park, Victoria.** *Cunninghamia* 11(1): 1-26.

Hunter, J.T. and Bell, D. (2009). **The** Carex **Fen vegetation of northern New South Wales.** *Cunninghamia* 11(1): 49-64.

Kubiak, P.J. (2009). **Some fire responses of bushland plants after the January 1994 wildfires in northern Sydney.** *Cunninghamia* 11(1): 131-65.

Maccherini, S., Bacaro, G. Favilli, L., Piazzini, S., Santi, E. and Marignani, M. (2009). **Congruence among vascular plants and butterflies in the evaluation of grassland restoration success.** *Acta Oecologica* 35(2): 311-317.

Myerscough, P.J. (2009). **Fire and habitat interactions in regeneration, persistence and maturation of obligate-seeding and resprouting plant species in coastal heath.** *Proceedings of the Linnean Society of New South Wales* 130: 47-61.

Page, M.J. and Harrington, R.A. (2009). **Fourteen months of seed rain in three Australian semi-arid communities.** *Austral Ecology* 34(3): 294-305.

Special Issue: Biology and Conservation of Caladenia. *Australian Journal of Botany* 57(4) (2009).

Waters, C.M., Melville, G. and Jacobs, S. (2009). **Association of five** Austrodanthonia **species (family Poaceae) with large and small scale environmental feature in central western New South Wales.** *Cunninghamia* 11(1): 65-80.

Information Resources and Useful Websites

Directory of Australian Botanic Gardens and Arboreta

http://www.anbg.gov.au/chabg/bg-dir/

This directory lists more than 150 botanic gardens and arboreta around Australia. For each place, a standard set of information is provided, including physical location of the gardens, its size, the proportion of the living collection that is native species, whether there is a threatened species program, whether there is a public access herbarium and whether there is an active Friends' group.

Flora of Tasmania Online

http://www.tmag.tas.gov.au/index.aspx?base=4116

The Flora of Tasmania Online was launched in June 2009. It is a publicly available web-based resource for the identification of plants and the dissemination of modern taxonomic information. It will present information on all flowering plants, native and naturalised, found in Tasmania, including descriptions, keys, taxonomic relationships, distributions and ecology. It will be published progressively, with each family treatment available as a downloadable PDF file and web pages. At the time of writing (21 August 2009), treatments for 49 families were available.

Australia's Biodiversity and Climate Change

W. Steffen, A.A. Burbidge, L. Hughes, R. Kitching, D. Lindenmayer, W. Musgrave, M. Stafford Smith and P. Werner

Commonwealth of Australia, 2009

The Australian Government commissioned an assessment of the vulnerability of our nation's biodiversity to climate change to help increase understanding of how to help Australia's rich biodiversity adapt to climate change. The assessment finds that our biodiversity is at risk from even moderate climate change and already under stress, for example from habitat degradation, changed fire regimes and invasive species. Climate change is likely to exacerbate these existing stressors and add additional stresses such as through declining water availability.

The main report of the assessment is available only in pre-publication form as a non-printable PDF, and will be published as a book by CSIRO Publishing in late 2009. The accompanying reports—*Biodiversity vulnerability assessment summary for policy makers* and *Technical synthesis*—can be printed from the web. All three documents are available online at <www.climatechange.gov.au/impacts/biodiversity_vulnerability.html>.

The Convention on Biological Diversity Plant Conservation Report: A review of Progress in Implementing the Global Strategy for Plant Conservation (GSPC)

Secretariat of the Convention on Biological Diversity, Montreal, Canada, 2009, 48 pp.

The 2002 Global Strategy for Plant Conservation was adopted with the aim, in part, of halting the loss of plant diversity in all countries. The strategy contains 16 targets, some of which are particularly relevant to ANPC activities. They include targets relating to protocols for plant conservation based on research and practical experience (target 3), in situ and ex situ conservation of threatened plant species (target 8); communication, educational and public awareness programs related to plant diversity and its conservation (target 14); and the role of networks for plant conservation (target 16).

In-depth reviews of progress towards meeting the strategy's targets by those nations that have signed the Convention on Biological Diversity have recently been concluded. A summary of the review results for each target have been published in the Plant Conservation Report which also highlights major issues for plant conservation in the future. The report also acknowledges the role of non-government organisations, including ANPC (see page 11 of the report), that have been active in enhancing implementation of the strategy. The report can be downloaded from <www.cbd.int/doc/publications/plant-conservation-report-en.pdf>.

Introduction to plant life in New Zealand

New Zealand Plant Conservation Network, 2009, pp 70, NZ $45

This is the first module of a plant training course prepared by the New Zealand Plant Conservation Network. It includes chapters on plant names; where plants grow and why; flowers, spores, seed and fruit; leaves, stems, bark and roots; plant identification and collecting plant specimens for identification. The booklet can be purchased from the NZ Plant Conservation Network, PO Box 16-102, Wellington, NZ.

Information Resources and Useful Websites (cont.)

New Models for Ecosystem Dynamics and Restoration

R. J. Hobbs and K. N. Suding

Island Press, 2009, pp 512, paperback,
ISBN: 9781597261852, AU $99.95

This book aims to help scientists and restorationists correctly diagnose ecosystem damage, identify restoration thresholds, and develop corrective methodologies that can overcome such thresholds. In the first part of the book, background chapters present and discuss the basic concepts and models and explore the implications of new scientific research on restoration practice. The second part considers the dynamics and restoration of different ecosystems, ranging from arid lands to grasslands, woodlands, and savannahs, to forests and wetlands, to production landscapes. A summary chapter discusses the implications of theory and practice of the ideas described in preceding chapters. The book is available from <www.publish.csiro.au/pid/5935.htm>.

Invasive Alien Species: A New Synthesis

H.A. Mooney, R.N. Mack, J.A. McNeely, L.E. Neville, P.J. Schei and J.K. Waage (eds)

Scientific Committee on Problems of the Environment (SCOPE) Series, Island Press, USA, 2005, 352 pages
Hardback ISBN: 155963362X, AU $140
Paperback ISBN: 1559633638, AU $39.95

Invasive alien species are among today's most daunting environmental threats, costing billions of dollars in economic damages and wreaking havoc on ecosystems around the world. In 1997, a consortium of scientific organisations developed the Global Invasive Species Programme (GISP) with the explicit objective of providing new tools for understanding and coping with invasive alien species.

Invasive Alien Species is the final report of GISP's first phase of operation, 1997–2000, in which authorities from more than thirty countries worked to examine invasions as a worldwide environmental hazard. The book brings together the world's leading scientists and researchers involved with invasive alien species to offer a comprehensive summary and synthesis of the current state of knowledge on the subject.

The Alice Springs Desert Park is one of the botanic gardens in Australia that grows only native plants. Photo: Rosemary Purdie.

ANPC Conferences and Workshops

ANPC Plant Identification Workshops in the ACT

Native Grass ID
(beginners/or with minimal experience)

10 November (Tuesday)

Plants of Grassy ecosystems
(beginners/or with minimal experience)

11 November (Wednesday)

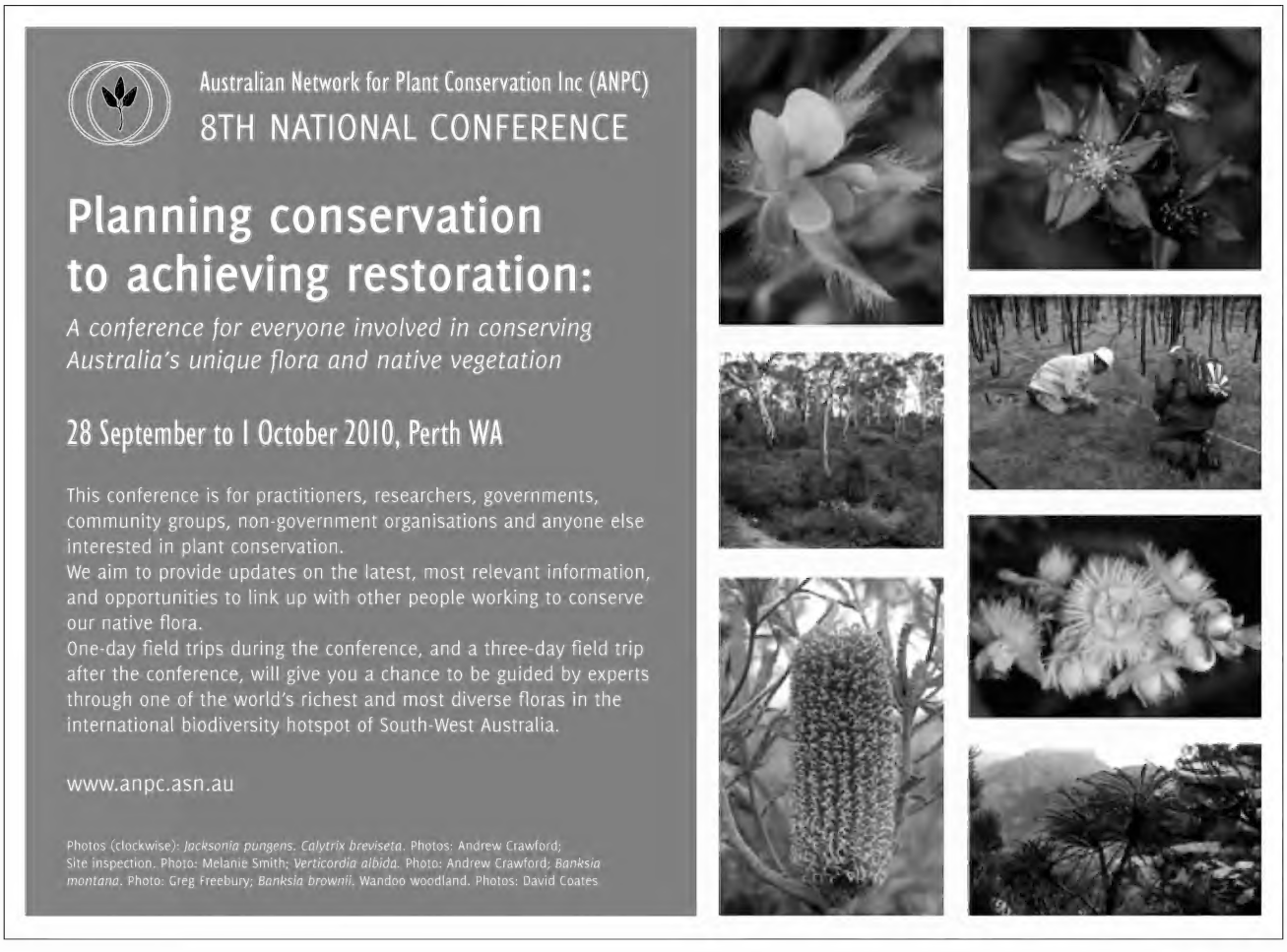
Location: Canberra (starting at the Australian National Botanic Gardens)

For more information and workshop costs email anpc@anpc.asn.au or ph: 02 6250 9509

ANPC National Conference for 2010

28 September to 1 October 2010, Perth WA

Put the dates for the ANPC national conference in your diary now, and don't forget there will be a post-conference field trip on 2-4 October (see below).



Conferences and Workshops

Charles Darwin University & NT Government
Charles Darwin: Shaping our Science, Society & Future

22-24 September 2009
Darwin, NT

The year 2009 marks the 200th anniversary of the birth of Charles Darwin and the 150th anniversary of his work *The Origin of Species*. Through a combination of meticulous observation and innovative thinking, Darwin developed an explanation for the incredible variety of living things: that evolution is driven by natural selection. The symposium will provide an opportunity to appreciate, debate, and even challenge Darwin's findings, and will bring together an exciting range of speakers from around the globe.

Further information: http://www.cdu.edu.au/cdss

Conference of the Association of Societies for Growing Australian Plants
Australian Plants in the 21st Century

26 September - 2 October 2009
Geelong, Vic.

The conference presentations include topics such as using native plants in contemporary landscapes, native plants and climate change, seed banking, covenanting to protect native flora, ecosystem decline in isolated habitats, threatened species research and many others. Excursions to the Otway Ranges and Royal Botanic Gardens, Cranbourne are also on the agenda.

Further information: http://asgap2009.apsvic.org.au/

Botanic Gardens of Australia and New Zealand (BGANZ) Congress 2009
Plan(e)t Priority: Regional Reality

8-10 October 2009
Mackay, Qld

Presentations and papers for the congress include topics such as delivering living collections information online, rethinking botanic gardens in the face of climate change, the role of seedbanks in a changing environment, the significance of regional botanic gardens and their role in climate change resilience, and engaging the community to bring plants to life. Field trips associated with the congress will provide an introduction to the hinterland landscapes around Mackay.

Further information:
http://www.bganz.org.au/congress.html

Queensland Landcare Conference
Legends, Larrikins & Landcare

14-17 October 2009
Longreach, Qld

The conference will showcase land and water management practices involving everything from water wise gardens, the control of woody and exotic weeds, to feral animal control and the rehabilitation of natural water courses. The conference program consists of plenary sessions, with keynote presentations by well known industry representatives, and field trips.

Further information:
http://www.iceaustralia.com/qldlandcare09/

Environment Institute of Australia & New Zealand Conference
Policy to Practice

20-21 October 2009
Canberra, ACT

One of the most challenging tasks for environmental professionals today is being able to thoroughly understand and practically implement the environmental policies of a national government. Over the last few years, the national environmental policy framework in Australia and New Zealand has changed significantly. The policy issues relevant to plant conservation that are expected to be covered at the conference include biodiversity conservation, climate change, environmental offsets, land management (Indigenous land, protected areas) and wetlands.

Further information: http://www.conlog.com.au/eianz/

Australian Systematic Botany Society (ASBS) Conference
Systematic botany: from science to society

29 November - 6 December, 2009
University of New England, Armidale, NSW

The conference will highlight the discovery, analysis and synthesis in plant diversity research and its impact on society. The keynote speaker will be Professor Peter Stevens, Professor of Biology, University of Missouri, St Louis and Curator, Missouri Botanical Garden. The conference will include a workshop on 'National accreditation of providers of biological identification', a topic that extends naturally to broader issues of quality assurance in identification, the critical role of vouchers, herbaria, identification and planning tools and the corresponding need for taxonomic botany positions in State and national Herbaria.

Further information: from ASBS website <http://www.anbg.gov.au/asbs/> or from Jeremy Bruhl (jbruhl@une.edu.au)

Conferences and Workshops (cont.)

Ecological Society of Australia Symposium
The worlds of ecology & environmental policy– never the two shall meet?

4 December, 2009
Canberra, ACT

The symposium will use bushfire as a case study. Further information: http://www.ecolsoc.org.au/ConferenceListing.html

Island Arks Symposium 2009
Island ecosystems, management and sustainable use

7-11 December 2009
Daydream Island, Qld

The symposium aims to bring together practitioners in a wide range of disciplines to identify, discuss and resolve management challenges and identify pathways for long-term conservation and sustainable use of island ecosystems. Proposed themes cover topics such as floristics, management issues including invasive species, conservation planning, islands as repositories for biodiversity, and translocation locations for threatened species. Keynote speakers include Professor Bob Pressey, James Cook University and conservation biologist Andrew Burbidge from Western Australia.

Further information: http://www.islandarks.com.au/

Advanced notice of other conferences

XVIII International Botanical Congress

23-30 July 2011, Melbourne, Vic. Further information: http://www.ibc2011.com/Program.htm

The IBC website is calling for symposia topics and organisers. Those interested in the possibility of helping ANPC to organise a symposium session under the 'Ecology, environmental change & conservation' theme, or to help with general ANPC activity at the conference, please contact bob.makinson@rbgsyd.nsw.gov.au (ph 0408 116 488) as soon as possible.

Robert Boden (1935-2009)

It is with great sadness that the Director of the Australian National Botanic Gardens and the Director of National Parks and their staff acknowledge the death on Sunday 30 August of Dr. Robert Boden.

Robert was the first Director of the Australian National Botanic Gardens, serving in that role from 1979 until his retirement in 1989.

During his time as Director the Gardens' Education Programs were established, the Rock Garden was constructed and Visitor Centre and Theatrette were built. With his science background he promoted the research role of the Gardens and his special interest in rare and threatened plants led the Gardens towards its current emphasis on conservation.

He maintained his interest in the Gardens long after his retirement and in 2005 was honoured with a plaque on the edge of the Eucalypt Lawn among the gum trees that had been a special passion.

We all feel a deep loss for a person who was so passionate about and intimately involved with the Gardens and extend our condolencecs to his family and friends.

As appeared in The Canberra Times, 2 September 2009

The ANPC would also like to acknowledge that Robert Boden was very supportive of the establishment of ANPC. More information on Robert Boden's life can be found on the ANBG website:

http://www.anbg.gov.au/biography/boden-robert.html

ANPC Corporate Members

ANPC acknowledges the support of the following corporate members

Albury Botanic Gardens, NSW

Australian National Botanic Gardens, ACT

Botanic Gardens of Adelaide, SA

Botanic Gardens Trust, NSW

Centre for Plant Biodiversity Research

Department of Environment and Conservation, WA

Dept of Sustainability and Environment, VIC

ForestrySA

Greening Australia, VIC

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Sydney Olympic Park Authority, NSW

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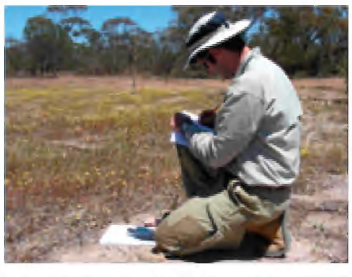
Greening Australia

Plant Germplasm Conservation in Australia

Strategies and Guidelines for developing, managing and utilising *ex situ* collections

Edited by: C.A. Offord and P.F. Meagher
ANPC in partnership with MSB Australian Partners



Chapter 1: Introduction, including Plant Conservation in the international and Australian contexts

Chapter 2: Germplasm conservation options and major considerations

Chapter 3: Seed and Vegetative material collection

Chapter 4: Seed Banking

Chapter 5: Seed Germination and Dormancy

Chapter 6: Tissue Culture

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Chapter 8: Living Plant Collections

Full of practical case studies to demonstrate principles of germplasm conservation in Australia

A handy companion to the 'Guidelines for the Translocation of Threatened Plants in Australia' (Second edition)

SUPPORTED BY: ANBG, LWA, BGT (NSW), DEH (SA), RGB KEW

AVAILABLE NOW

Refer to Website for Order form
http://www.anpc.asn.au/books.html or from the ANPC Office (details below)

Australian Government
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exchange
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MILLENNIUM SEED BANK PROJECT Kew

Australasian Plant Conservation
BULLETIN OF THE AUSTRALIAN NETWORK FOR PLANT CONSERVATION INC

For further information contact:
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